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ABSTRACT

The principal purpose of this empirical study was to identify factors in the backgrounds and college experiences of American undergraduate students that affect their interest in studying science and in pursuing science-related careers. Four-year longitudinal data were obtained from 27,065 freshmen who entered 388 four-year colleges and universities in the fall of 1985 and were followed up four years later in the fall and winter of 1989-90. Scores on college admissions tests and on graduate and professional school admissions tests taken four years later were included. Survey data were also obtained from students' faculty. Between the freshman and the senior years, the percentage of students majoring in fields of natural science, mathematics, and engineering (SME) declined from 28.7 to 17.4. Losses were greatest in the biological sciences and next in engineering. Despite the declining interest of students in science majors and careers during the college years, interest in obtaining masters and doctoral degrees increased during the same period. The strongest predictor of changes in students' interest in science majors or careers is the students' entering level of mathematical or academic competency. The greater the proportion of a student's peers majoring in a SME field the more likely that person is to choose a career in the same field. Appendixes include the survey forms, site visit protocols, and a 55-page table providing profiles of persisters, defectors, and recruits. (Contains 78 references.) (PR)

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ED 362 404

Final Report

Undergraduate Science Education: The Impact of Different College Environments on the Educational Pipeline in the Sciences

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Principal Investigators

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National Science Foundation
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PREFACE

This is a highly complex empirical study with many findings. The Executive Summary provides an overview of the method, main findings, and major policy implications. Readers should be advised that each chapter contains a detailed summary section that attempts to capture the principal empirical findings discussed in the main body of the chapter. Since a final summary chapter would be almost entirely redundant with these chapter summaries and the Executive Summary, we have decided not to include a summary chapter in this report.

This research project was a collaborative effort of the staff at Higher Education Research Institute. All of us participated in the data collection, analysis and preparation of the final report. Individuals were assigned primary responsibility for drafting certain sections, as shown below:

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Finally, we are indeed appreciative of the National Science Foundation for providing us with the funding resources for this project. We are especially indebted to Iris Rotberg for her advice and support during the first year and a half of this project. We would also like to acknowledge the Exxon Education Foundation for their earlier support of a study of general education outcomes which made possible the collection of the data used in this study.

Alexander W. Astin, Helen S. Astin

November, 1992

EXECUTIVE SUMMARY

The principal purpose of this empirical study was to identify factors in the backgrounds and college experiences of American undergraduate students that affect their interest in studying science and in pursuing science-related careers. Four-year longitudinal data were obtained from 27,065 freshmen who entered 388 four-year colleges and universities in the fall of 1985 and were followed up four years later in the fall and winter of 1989-90. In addition to the longitudinal questionnaire data, scores on college admissions tests (SAT or ACT) and on graduate and professional school admissions tests taken four years later (GRE and MCAT) were also obtained. For 24,331 of these students, extensive survey data were also obtained from members of their faculties during 1989-90.

Changes in Careers and Majors During the Undergraduate Years

Between the freshman and the senior years, the percent of students majoring in fields of natural science, mathematics, and engineering (SME) declines from 28.7 to 17.4, a 40 percent relative decline. Losses are greatest in the biological sciences (50 percent decline) and engineering (40 percent decline). The net loss in the physical sciences (including mathematics) is substantially less (20 percent decline) in part because these fields recruit substantial numbers of engineering dropouts during the undergraduate years. Indeed, there is evidence (see below) to suggest that the presence of a very large program in the physical sciences can accelerate the loss of engineering students by attracting substantial numbers of these students away from engineering into the physical sciences and mathematics.

Inclusion of psychology and the social sciences among "sciences" reduces the net loss during the undergraduate years by about one-half. However, given that there is very little "traffic" between psychology/social science and traditional SME fields during the undergraduate years, it is probably unwise to combine these two large groupings into a single "science" category.

Considered as a career, engineering loses more than half of its students (53 percent decline) during the undergraduate years. A similar loss (51 percent decline) occurs among students pursuing careers as scientist/practitioners (primarily medical careers). However, the proportion of students aspiring to careers as research scientists (including college teachers of science) actually shows a slight increase from (3.3 to 3.7 percent of the students) during the undergraduate years. When all science-related careers are considered together (research scientist, engineer, scientist/practitioner), the number of students pursuing such careers declines from one in four (25.1 percent) to fewer than one in seven (14.2 percent) of the undergraduates.

Degree Aspirations and Transition to Graduate School

Despite the declining interest of students in science majors and careers during the college years, interest in obtaining masters and doctorate degrees increases during this same period. Consistent with declining interest in scientist/practitioner careers, interest in the medical degree declines sharply. Increased interest in masters' degrees (specifically in business) is greatest among students pursuing engineering careers, whereas increased interest in the PhD is strongest among students planning to become research scientists or college science teachers.

Factors Affecting the Choice of Science Careers and Majors

Longitudinal multivariate analyses were used to assess the impact of "environmental" factors (different types of institutions, programs, faculties, student peer groups) on choice of a science major or science career. More than 100 potentially biasing characteristics of the entering freshmen were first controlled before the impact of environmental variables was assessed.

The strongest and most consistent predictor of changes in students' interest in science majors or careers is the students' entering level of mathematical and academic competency. Well-prepared students are more likely than other students both to persist in their initial choice of a science major or career and to be recruited into science majors and careers during the undergraduate years. Mathematical and academic preparation are also positive factors in the student's initial (freshman) interest in scientific majors and careers. These positive effects of mathematical and academic preparation have important implication for future science education policy. For one thing, they suggest that the numbers of students pursuing science majors and careers at the point of college entry and the numbers maintaining (and switching into) such choices during the college years could be increased if the overall level of mathematical competency in the high school population could be increased. There is also evidence to suggest that the numbers of students pursuing science majors and careers could be increased if the level of overall academic competency could be increased at the secondary level.

Given that mathematical preparation and overall academic preparation are also related to the student's interest in pursuing advanced degrees, raising the overall level of mathematical and academic competency at the high school and college undergraduate levels would also be likely to increase the number of college graduates who go on to pursue advanced degrees in the sciences and engineering.

The net loss in the percentages of students pursuing science majors and careers during the undergraduate years are roughly proportionate for men and women, although women are slightly more likely to defect from engineering majors and careers. Women are slightly more likely than men, however, to be recruited into psychology during the undergraduate years.

When it comes to race or ethnicity, Asian-American students show the strongest predilection for SME majors and careers (especially engineering); they also show the smallest proportionate losses from science majors and science careers during the undergraduate years. White students show larger proportionate losses from scientist-practitioner careers during college than do other racial/ethnic groups.

A number of environmental factors were found to have significant effects. Student interest in pursuing science majors and careers can be affected both by the characteristics of the peer group as well as by the type of pedagogy the institution employs. The clearest and most consistent pattern of environmental effects on student choice outcomes is associated with the concentration of student peers in various fields of study. Basically, the greater the proportion of a student's peers who are majoring in a particular SME field, the greater the likelihood that that student will end up choosing a career in the same field. For at least three categories of SME choices—physical science major, engineering major, and engineering career—the effect is nonlinear, with the curve accelerating at the high end of the distribution of relevant majors. This finding suggests that the ability of an undergraduate SME major or program to retain or attract students depends in part on its reaching a certain "critical mass." However, it also appears that, as particular SME fields increase in size, they may compete for students with other SME fields. This is especially true in the case of programs in the physical sciences, which appear to attract students away from engineering as they increase in size.

Other evidence supporting the importance of the peer group on choice of a science major or career includes the positive effects of participating in honors programs and tutoring other students and the negative effects of working off campus. Science students' satisfaction with their undergraduate experience is also negatively affected by a lack of community on the campus. Peer group effects may also help to explain the positive effect of living on campus on aspirations for advanced degrees.

Acquisition of Scientific Knowledge and Quantitative Competence

Much of the variance in GRE and MCAT performance four years after entering college can be attributed to preexisting differences at the point of college entry. Among other things, this result highlights the importance of precollegiate preparation: to a large extent students' performance at the time of graduation from college is constrained by precollegiate preparation, regardless of what happens in college.

Findings regarding other precollegiate (input) factors are a cause for concern. That African American students perform less well on the graduate admissions tests than would be expected from their college admission test scores suggests that their undergraduate educational experiences are not enhancing their scientific knowledge and mathematical skills to the same extent as is found with members of other racial/ethnic groups. Thus, the substantial gaps in performance between African American and other students that already exist at the time of college entry are actually widened during college. A similar scenario characterizes the results for women. Performance gaps favoring men at the point of college entry appear to widen during the undergraduate years, as reflected in performance on the GRE Quantitative test and MCAT. A notable exception here is the GRE Analytical test, where women actually perform better than do men with comparable SAT scores at college entry.

Since the environmental factors that affect test performance are very different from those that enhance students' interest in science, policies designed to enhance test-taking ability may not have much of an effect on the number of students choosing science majors or careers. For example, scores on both the GRE Quantitative and MCAT tests appear to be enhanced by exposure to a peer group with high intellectual self-esteem and "peer competition" among students. Since peer groups that are high in intellectual self-esteem would be likely to include many students who are interested in science and math and who intend to pursue postgraduate study, simply affiliating with such a peer group for four years may well provide the student with a more "science-oriented" experience which could add something to his or her scientific and mathematical knowledge through informal conversations, cocurricular activities, and other out-of-class experiences. Furthermore, exposure to such a peer group would also enable the student to acquire more "tricks of the trade" in preparing for graduate and professional school admissions tests.

The Undergraduate Experience in Science Education

The study provides extensive evidence documenting the importance of pedagogical practice. In particular, the student's interest in science majors and scientific careers appears to be positively affected by conducting independent research, by assisting faculty in teaching courses, and by involvement in faculty research projects. These same activities also enhance the student's satisfaction with science courses, with faculty, and with the overall institutional experience.

Having a faculty that is strongly student-centered enhances persistence in biological science majors, recruitment into research careers (including college teaching), and satisfaction with the faculty and curriculum. By contrast, having a strongly research-oriented faculty reduces persistence among physical science majors and negatively affects student satisfaction. This last finding can be explained in part by the tendency for strongly research-oriented faculties to rely heavily on teaching assistants in their undergraduate courses.

Consistent with previous research suggesting that small liberal arts colleges tend to "over produce" scientists, attending a large institution has negative effects on student persistence in science majors and careers and on aspirations for advanced degrees. These effects appear to be mediated in part by student-faculty contact: students generally have relatively little contact with faculty in the larger institutions. Considering that our largest institutions, including many major research universities, train most future college teachers, it is somewhat ironic that these same institutions tend to have a negative effect on the undergraduate's interest in pursuing careers both in scientific research and in college teaching.

The Science Faculty

The study also revealed a number of striking differences in the pedagogical practices of science and nonscience faculty. Compared to faculty in other fields, science faculty use more hierarchical and authoritarian approaches in the classroom and are less likely to be student-centered in their pedagogy. Specifically, science faculty are less likely to encourage students to participate in classroom discussions, to employ cooperative learning strategies, or to encourage student-selected topics. They are also more likely to lecture, to use multiple choice exams, and to feel that the quality of their students is poor. They are less interested in the student's personal development and less concerned with society's ills and problems than nonscience faculty. As would be expected, science faculty are also more likely than faculty in other fields to indicate that their own interests lean toward research more than teaching.

Institutional Differences

The study also provides a number of insights as to the types of educational experiences typically encountered by science majors in different types of institutions. Especially dramatic are the differences between the major universities and the liberal arts colleges in the experiences of their science students. Beyond the more obvious attributes of universities—the frequent use of graduate teaching assistants, the large classes, and the strong faculty inclination toward research—we also find fewer opportunities for meaningful contact with faculty among university students compared to their peers attending liberal arts colleges. All of these factors may well combine to create an environment that serves to alienate university students and to discourage them from the study of science.

Finally, the study provides some important clues as to how undergraduate institutions of all types can make their science programs more attractive and stimulating. Institutional leadership appears to play a crucial role. In particular, the data suggest that faculty will be much more likely to use active forms of teaching and learning if they work in an environment that encourages interdisciplinary work, team teaching, and the incorporation of women's and ethnic perspectives in the general education curriculum. Indeed, a general campus climate of concern with issues of diversity seems to encourage the use of student-centered pedagogy.

Five Case Studies

Many of these empirical findings are reinforced by the case studies. Five case study institutions were selected because the quantitative data showed them to be especially successful in encouraging retention and recruitment of students into SME majors and careers. The common elements observed on each of these campuses by our site visit teams include an emphasis on teaching, the availability of research opportunities for undergraduates, high levels of faculty-student interaction, a supportive campus climate, and a high priority placed on undergraduate education. Even in the two research universities we visited, where graduate education received considerable emphasis, undergraduates were still considered to be equally important institutional clients. This priority was reflected by the fact that virtually none of the science or engineering departments used graduate students to teach undergraduate courses. Moreover, undergraduates were given just as many opportunities for research as were the graduate students. In short, we did not encounter the typical hierarchical arrangement—faculty-graduate students-undergraduates—that exists at most research universities. Although the case studies also revealed that innovative teaching methods were well received by students in the sciences, many faculty remain hesitant to alter their traditional lecture approach in the classroom.

CHAPTER 1

Introduction

Scientific research and technological development are closely linked to the economic strength of this country and its international standing. In fact, scientific research is one of the few areas where the United States continues to hold a preeminent world position. To this day, the lion's share of Nobel Prizes is awarded to American researchers. However, a significant deterioration in the so-called "pipeline" of young people seeking science, mathematics and engineering (SME) careers threatens the vitality of the national research effort.

Over the last decade there has been heightened recognition of the need to reform science education. As the nation becomes increasingly dependent on science and technology, fewer college students are expressing an interest in scientific fields of study. This diminishing pool of talented individuals with expertise in the natural sciences and engineering is being called upon to address an increasingly wide variety of issues including national security, international economic stability, medicine and health care, and social reform. In order to meet future national needs in science and technology, we need to address the question of what institutions of higher education can do to attract and retain more students in the sciences. The present study examines SME talent among undergraduates attending American colleges and universities. It uses longitudinal data from a national sample of American undergraduates to examine a wide range of factors that can influence students' interest in science, aspirations for scientific careers, and quantitative learning during the undergraduate years.

Overview of Recent Literature

Recent studies of changes in the career and major field preferences of American undergraduates (Dey, Astin, & Korn, 1991; Green, 1989) indicate that the percentage of freshmen selecting SME majors and careers is decreasing (see tables in Appendix D for trends). In addition, Census data reveal that colleges and universities in the U.S. have experienced a decline in enrollments in their science and engineering programs. For example, in 1980, the total number of bachelor's degrees conferred in engineering was 68,893. While this figure rose to 94,444 in 1984, by 1988 it had dropped to 88,791. A more dramatic decline has occurred in the life sciences. In 1980, the number of degrees conferred in the life sciences was 46,370. This figure dropped in 1984 to 38,640 and in 1988 the number had dropped even further to 36,736 (U.S. Bureau of the Census, 1991).

There is also evidence that interest in science is declining at the pre-college level. Yager and Penick (1986) have reported a sharp decline in the percentage of students who report that science is interesting (and the concomitant increase in reports that science is boring) as students go through the K-12 system.

A related concern is the level of scientific achievement among American students. The International Association for the Evaluation of Educational Achievement (IEA) conducted a study of science achievement in 17 countries. The study found the achievement levels of American ten-year-olds to be about average when compared to countries like Australia, Finland, Hong Kong, Hungary, Japan, the Philippines, Poland, Sweden, and Thailand. American 14-year-olds, however, tied for fourteenth place, and American high school seniors, came in last, or close to last, depending on the discipline. The authors of this international study said this about the United States: "For a technologically advanced country, it would appear that a re-examination of how science is presented and studied is required" (1988, p. 9).

Still another concern is related to the gender and ethnic diversity of the scientific work force. In addition to strong equity concerns, it is important to note from a practical perspective that the scientific work force could be substantially increased if women, African Americans and Latinos were to enter the sciences in the same proportions as white and Asian American men.

In order to better understand the problems of SME education and to develop potential solutions, researchers have examined a variety of elements that may influence students' attraction to and retention in the sciences. A useful metaphor for discussing these issues is the science "pipeline," which indicates when and where students enter and leave the sciences. Factors that can affect these "flows" include role models, achievement levels, self-concept, classroom experiences, and the peer group.

The Science Pipeline

College is a crucial component in the science pipeline. This is the point at which young people must make career commitments, particularly if they are going into SME. The trends in the percentage of freshmen selecting SME majors and careers have been documented previously by researchers from the Higher Education Research Institute (HERI) (see Dey, Astin, & Korn, 1991).

But what happens at the pre-collegiate level? As noted earlier, the number of students who find science interesting seems to shrink as students progress through the K-12 school system. In demonstrating this point, Yager and Penick (1986) concluded that, "the more years our students enroll in science courses, the less they like it. Obviously, if one of our goals is for students to enjoy science and feel successful at it, we should quit teaching science in third grade. Or perhaps we should try teaching it differently" (p. 360).

Carl Sagan (1989) commented that when he visited a kindergarten class he found himself in a class full of young scientists, who asked provocative, enlightening, insightful questions and who were clearly enthused and excited about science. But when he visited a high school class, the students were much less interested. Somewhere between kindergarten and high school students have lost interest and enthusiasm in science. Some research suggests that the danger area may be junior high school.

Among those who locate junior high school as a critical time in the educational pipeline are James and Smith (1985) who observe:

> There are some disturbing explanations for such a dramatic drop in positive attitude toward science at the seventh grade level. One possibility is that the seventh grade is often the first time that science is treated as a separate subject in a separate classroom. Further, it is usually required at this grade level. Seventh grade science may be one of the earliest attempts to require students to use self-directed problem solving techniques to a greater degree than in earlier grades. Perhaps this additional rigor explains the response. Since K-6 science is frequently not graded, seventh grade may be the first time students' work has been evaluated. (p. 45)

F. James Rutherford who, in a report to the American Association to the Advancement of Science, concludes: "You have to know something is wrong when teaching something as exciting as science can result in most of us disliking it" (Connel, 1989, p. 26).

Berryman (1983) analyzed the educational paths that provide the "talent pool" for scientific professions. She found that students' interest in science first appears in elementary school and the numbers grow until just before the 9th grade. During high school a few students enter the pool but many more exit. By the time students enter college the flow is almost entirely outward.

The science pipeline for women has a slightly different pattern. Oakes (1990c) describes the underrepresentation of women in science as a reflection of their declining participation in science throughout the educational pipeline. While girls in elementary school exhibit the same math and science abilities as boys do, they express less interest in these fields. By junior high school, achievement of boys and girls is still comparable within math and science courses, but girls are taking fewer math and science courses than boys are. By senior high school, women are taking even fewer courses in math and science relative to men (Dearman & Plisko, 1981; Frieze & Hanusa, 1984; Matyas, 1985). Since high school math and science courses are usually prerequisites for college science courses many women lack the academic preparation which is necessary to pursue scientific fields in college (Brush, 1985; Oakes 1990a, 1990c; Vetter, 1989). At the point of college entry, women's interest in science is well below that of the men. Among college freshmen in 1990, 24% of men, and only 7% of women, reported that they would major in biological science, physical science, or engineering (Dey, Astin, & Korn, 1991).

Unlike women, African American and Hispanic students begin the process of dropping out of the science pipeline as early as elementary school (Oakes, 1990a; 1990b). Differential achievement levels seem to play a crucial role here. African Americans and Hispanics often exhibit lower achievement scores in math and science than do white and Asian American students (Oakes, 1990c). As a result, many African American and Hispanic students are placed into remedial educational tracks early in their education. These lower tracks tend to require fewer math and science classes (Oakes, 1990a; 1990b). By the time they reach high school age, these minority students are not able to compete at the level of their white counterparts. As students reach college age, the gap between minority students and white students widens. African American and Hispanic students are thus less likely to enroll in college than are white or Asian American students (Oakes, 1990c), and those who do enroll are less likely to major in a science or engineering field (Task Force, 1988). Moreover, minority science majors are likely to receive lower college grades than white students, in part because of their inadequate high school preparation (Nettles, 1986).

In order to develop possible solutions to these problems, it is necessary to identify forces that may influence students' attraction and retention in the sciences. The following includes many of the salient concerns of science and mathematics reform.

Role Models and Mentors

It is widely believed that college students planning science careers need access to professors who are positive role models. Research indicates that faculty role models and mentors are particularly important for women and students of color. Through active encouragement, female role models promote positive attitudes towards mathematics among girls (Casserly, 1979; Casserly & Rock, 1985). A study of freshmen found that women with female high school mathematics teachers had higher SAT scores than women with all male teachers. The study also noted that women who had female role models in high school were three times as likely to receive A's in their college mathematics courses. This effect was not attributed to the superior teaching of women since it did not appear to impact the achievement of male students (Boli, Allen, & Payne, 1985) but rather to their roles as mentors. A study of first-year math honors students indicated that positive encouragement from faculty, friends and family had positive effects on retaining women in science (Women in Higher Education, 1992). It appears that women may be particularly receptive to support from role models. The encouragement of teachers, counselors, and family members may help them to overcome negative perceptions of mathematics and science.

Attitudes Toward Science and Mathematics

Research reveals that mastery of math may be the single factor most related to an individual's success in college and beyond. Sells (1973) coined the term "critical filter" to depict the importance of math achievement on college majors. With the increasing reliance on computers and statistics, many non-scientific fields such as business and social science are raising their math requirements for graduation (Steen, 1987).

However, negative attitudes about math achievement are often based on incorrect assumptions about who can learn this subject. The avoidance of math is the hidden factor that explains career decisions made by many young people (Tobias, 1978). There are people who want to be doctors and dentists but who choose other careers so they won't have to take math in college.

Classroom Experiences and Achievement in Science

Research indicates that even when our educational system works for white, middle-class, male students, it discourages women and minorities from SME careers (Oakes, 1990c; Tobias, 1990). The attitudes and expectations held by teachers about the capabilities of women and minority students often contribute to the problem. It's disturbing that many teachers erroneously believe that certain kinds of students cannot do math. It is tragic when students incorporate these devastating myths into their self-concepts and, as a result, lower their aspirations.

The nature of the actual experience in the science classroom also short-changes many students, especially women and students of color. In her work designed to assess the problem with science education in institutions of higher education, Sheila Tobias (1990) argues that no student should be allowed to leave the sciences "without a struggle." Tobias believes that much of the problem with undergraduate science education is in students' early college experiences with science. In assessing how students experience introductory science classes, Tobias looked at a group of students she labeled "the second tier." These students are important because, Tobias argues, keeping students with high aptitude and high interest in science is not enough to meet the increased need for scientists in the future. As Tobias puts it, students from the "first tier" are curriculum proof and will most likely succeed no matter what their experiences are in science classrooms.

This "second tier" is comprised of students with some aptitude for science and varying degrees of interest in pursuing science education. However, based upon their experiences in introductory college science courses, these students are driven away from pursuing study in science-related fields. She believes that if science education were to be restructured or reconfigured, many of these students would continue to pursue undergraduate science majors.

The curriculum, method of instruction, and evaluation techniques in the science classroom are the central problems identified by Tobias. She argues that introductory science courses are designed to weed out all but those who are in the "top tier." Science classes are extremely competitive, which proves to be intimidating for the majority of students who enter science courses. The students who participated in her study commented that one of the things they missed the most in these classes was the sense of community with their peers.

Peer Group Effects

Davis (1966) argued that undergraduate career choice is a function of "academic self-concept," which, in turn, is based on a student's assessment of his/her performance relative to that of other students in his/her college environment. There are two basic theories that are posed to explain students' performance in relationship to that of their peers. The relative deprivation theory that suggests that students will increase their sense of self and their aspirations if they are "big frogs in a small pond." A different school of thought is represented by the environmental press theorists, who argue that students' achievement and aspirations are a function of the social context. Basically, these theorists attribute different effects to the role of college quality and selectivity on students. According to the relative deprivation theory, selectivity should have a negative effect on aspirations because it has a negative effect on academic achievement (that is, a given student will have a harder time earning good grades at a highly selective college). Environmental press theory, on the other hand, maintains that selectivity should positively affect aspirations, since an undergraduate will perform best and aim highest at a school where most of his/her fellow students have high aspirations and are superior academically. While these two theories differ in their interpretation of peer effects both agree on the importance of peers on student aspirations, achievement and ultimate career choice.

The Present Study

The present study is designed to examine a wide range of environmental influences on the production of scientific talent using longitudinal data from a national sample of American undergraduate students. The study explores some of the following questions:

- What types of campus environments are most successful in preparing students for careers in the sciences?
- What types of campus environments are most successful in retaining student talent in the sciences?
- How important is the degree of faculty involvement in teaching and mentoring undergraduates (as opposed to research and outside professional activities)?
- How important is institutional type (small liberal arts colleges, research universities, etc.) in the development of scientific talent?
- Are there significant interactions between types of institutions, curriculum, student-faculty contact, and other environmental factors?

- Do the characteristics of the student peer groups (e.g., level of interest in science, degree of academic preparation, etc.) have any influence on the development of student interest in scientific careers?
- What environmental factors seem to be most important in the development of mathematical and quantitative expertise?

This research report includes ten chapters in addition to this Introductory chapter. Chapter 2 describes the methodology employed. It includes a description of the samples used and the methods of analysis. Chapter 3 presents a descriptive analysis of changes in majors and careers during the college years. Chapter 4 presents and discusses the factors that contribute to students' majoring in SME fields and to their aspirations for scientific and engineering careers. Chapter 5 presents an analysis of factors in persistence, defection, and recruitment into science and engineering (majors and careers). Chapter 6 identifies college experiences that affect cognitive growth as reflected in the mathematics part of the graduate record examination. Chapter 7 presents the analysis of findings with respect to pursuing graduate and/or professional education in SME fields. Chapter 8 examines what contributes to students' satisfaction with respect to science courses and lab facilities. It also looks at changes in self-esteem and expectations about doing science successfully. Chapter 9 deals with science faculty, and it examines their classroom behavior and pedagogical practices as well as their views and attitudes in general. Chapter 10 presents a summary of findings from site visits at five institutions that have been performing better than average with respect to undergraduate science education. Chapter 11 describes the various programs available at institutions of higher education designed to encourage the participation of students of color in science education. It looks at the types of institutions that host such programs and examines the impact of these programs on students' science aspirations and achievement.

CHAPTER 2

Data and Methods

This study's main goal is to examine the development of science and engineering talent among undergraduates attending American colleges and universities. The study involves the quantitative analysis of survey data collected from students and faculty at a diverse set of colleges and universities, as well as intensive case studies of five institutions which were identified (through a series of multivariate analyses) as being effective at promoting science–related outcomes among undergraduates. These site visits provide additional qualitative data on those campuses that have been particularly successful according to our analyses of outcomes. The purpose of this chapter is to provide an overview of the basic study design, and to provide details on the sampling and analytical procedures used in the quantitative portions of the study.

Design of the Study

Two basic types of analyses are used in this report: descriptive and causal. Descriptive analyses, which are intended simply to describe the current state of one variable (or a small set of variables), rely primarily on basic descriptive statistics ($\overline{X}$, S.D., etc.) and crosstabulations. For causal analyses, the study employs a conceptual framework used in previous longitudinal college impact studies (see Astin 1970a, 1970b, 1977, 1993). This model, the "input–environment–outcome" (or I-E-O) model is designed to address the basic methodological problem with all naturalistic (non–experimental) studies in education and the social sciences, namely the non–random assignment of people (inputs) to programs (environments). Since different types of educational programs tend to attract students who are different to begin with, the student "outcomes" of these programs may not necessarily reflect differential program impact, but simply differences in the characteristics of the entering students in the different programs.

The challenge to the researcher is thus to separate the "environmental" effects on student outcomes from the "input" effects. While one can never be absolutely sure that all possible biases resulting from differential student inputs have been identified and controlled, the purpose of the input–environmental–output design is to eliminate as much of the input bias as possible. The ultimate goal, of course, is to maximize the chances that any inferences about environmental influence will be valid. This goal is best realized by examining the effects of environmental variables only after first controlling for the effects of student input characteristics. Thus, in order to implement the I-E-O model, data are needed on "three conceptually different components: student outputs [or dependent variables], student inputs, and the college environment" (Astin, 1970a, p. 224). Using the I-E-O model and information about these three components, researchers search for the "differential effects of educational operations [i.e., college environments] on educational outputs" (Astin & Panos, 1971, p. 749).

Data Analysis

The most versatile method for implementing the input–environment–output model is blocked stepwise multiple regression analysis. A separate analysis was conducted with each dependent or outcome variable.

The basic procedure is first to control for the effects of input (control) variables, and then to determine if the environmental variables add anything to the prediction of the dependent variable. Both input and environmental variables can be entered sequentially ("blocked") according to their sequence of occurrence. Variables within each block are entered in a stepwise fashion until no additional variables within that block are capable of producing a significant reduction in the residual sum of squares of the dependent variable, after the next block of variables in the sequence is considered for entry.

Blocking of input variables is normally done within the following sequence: demographic characteristics, high school activities and achievements, and affective or subjective variables (aspirations, values, expectations for college, etc.) as assessed at the time of college entry. Environmental variables are normally blocked in the following sequence: between–institution variables, within–institution variables that can be known at the point of initial matriculation, followed by all other within–institution variables. Some explanation for the blocking of within–

institution environmental variables is needed. Within–institution variables that can be known at the point of entry (financial aid or place of residence, for example) are clearly antecedent in their order of occurrence to any of the dependent or outcome variables. On the other hand, environmental variables which can be known only after the student has been exposed to the environment for a period of time (time spent studying, for example) are not necessarily antecedent to the dependent variables. Thus, their possible causal relations to the dependent variables are ambiguous. Accordingly, the position of the 'intermediate outcome' measures in the regression is left until the very end and any findings based on their entry to the regression equation are necessarily interpreted with a considerable degree of caution. Any findings based on such variables are necessarily ambiguous and subject to alternative interpretations.

The basic rationale behind the input–environment–design is to rule out as many potentially biasing input variables as possible in order to minimize risk in interpreting possible causal relationships between environmental and outcome variables. A particularly interesting use of this form of stepwise regression is a technique developed at the Higher Education Research Institute which allows the investigator to get a detailed understanding of the colinearity among the various independent variables. Basically, the computerized regression routine allows one to follow changes in the partial correlations of *all* independent variables through each step of the regression analysis. By observing how the entry of one particular variable affects the partial correlations of all of the other variables (in and out of the equation) with the dependent variable, it becomes possible to determine how the colinearity is affecting the entire regression process at each stage. The I-E-O model is also discussed in the introductory sections of Chapter 4. For more details on the application of this model and on more technical matters such as how to deal with measurement error in the input variables, see Astin (1970a, 1970b, 1977, 1991).

Outcome (Dependent) Variables

The principal dependent variables for this study are listed below, and are covered in the following chapters:

- Choice of a scientific career (Chapters 3, 4, and 5)
- Choice of a science major (Chapters 3, 4, and 5)
- Quantitative and scientific skill levels (as measured by the GRE–Quantitative and MCAT tests; pretested with the SAT / ACT tests) (Chapter 6)
- Degree aspirations and the transition to graduate study (Chapter 7)
- Student satisfaction (with science and mathematics courses, laboratory facilities and equipment, library facilities, computer facilities, opportunities to discuss course work and assignments outside of class with professors; and amount of contact with faculty and administrators) (Chapter 8)
- Characteristics and pedagogical techniques used by science faculty (Chapter 9)

With the exception of the quantitative skill development, data were collected directly from students through a follow–up survey. The quantitative skill measure (along with performance data on other college and graduate admissions tests) was obtained directly from testing agencies. We believe that these scores represent an invaluable data resource for assessing the impact of various undergraduate programs and experiences on the mathematical and quantitative skills of undergraduates.

Environmental (Independent) Variables

Data on a variety of environmental variables were obtained from three main sources: a 1989 student follow–up questionnaire, the 1989 survey of faculty, and the institutional characteristics files of the Higher Education Research Institute. Two basic classes of variables were employed: "between–institution" environmental measures which characterize the entire institution, and "within–institution" environmental variables which can vary within a given institution from student to student.

Between-institution environmental variables include the following:

- Institutional "type" characteristics (size, selectivity, student–faculty ratios, per student expenditures for various purposes, federal support for research (total plus per student total), percent of graduate students in the student body, as well as a variety of dummy variables: university, four–year college, public versus private, single sex versus coeducational, geographic region, and predominant race of the student body).
- Faculty "climate" measures include certain *a priori* measures as well as measures obtained from a factor analytic study of mean faculty responses to selected survey questions; measures of obvious relevance to the current study include the relative involvement of faculty in research versus teaching, reliance on teaching assistants in lower division instruction, teaching loads, frequency and type of personal contact between faculty and students, scholarly productivity of faculty, and percent of faculty in science–related fields).
- Curriculum (characteristics of the general education curriculum such as structure (core versus distributional system, flexibility of choices available to students, degree of interdisciplinary emphasis in the curriculum).
- "Peer climate" measures (obtained through factor analytic studies of mean responses of the entire entering class to the 1985 freshman questionnaire. Measures of direct relevance to the current study include level of student interest in science, research, or graduate education, racial composition of the student body, sex ratio in the student body, and the socioeconomic level of the students' parents).

Within–institution variables known at the time of freshman entry include the following:

- Financial aid (relative reliance of students on support from parents, federal loans, grants, or work–study, institutional loans and grants, and other sources).

- Planned freshman place of residence (dormitories, private rooms or apartments, with parents).
- Initial choice of a major field of study

Other (later-occurring) within–institution ("intermediate outcome") measures include:

- Different forms of student "involvement" (in professors' research projects, assisting faculty in teaching courses, enrollment in honors courses, remedial courses, study abroad, college internship programs, and extracurricular activities).
- Work patterns (hours of employment, place of employment, type of work).
- Time allocation (relative hours per week spent studying, attending classes or labs, socializing, participating in research, watching television, using computers, and so on).
- Type and amount of contact with faculty (from the students' perspective; also to be measured from the faculty's perspective, as noted above).

Input (Control) Variables

Information on input or control variables was obtained from the questionnaire completed when the students entered college as freshman in 1985 and from the admissions tests scores described above. Specific input measures include the following:

- "Pretests" on relevant outcome or intermediate outcome variables.
- Demographic characteristics (race, gender and religion; parental income, education, and occupation).
- Secondary school achievements and activities (grade point average, election to academic honor societies, participation in science contests, use of a personal computer).
- Reasons for attending college (to gain a general education, to learn more, to prepare for graduate school, to get a better job, to make more money, etc.).
- Personal values (importance of making a theoretical contribution to science, becoming an authority in one's field, obtaining recognition from colleagues, etc.).

- Expectations for college (to change major, change career, graduate with honors, drop out or transfer, be satisfied with college, etc.).
- Self–concept (self–ratings on academic ability, mathematical ability, drive to achieve, intellectual self–confidence, etc.).
- High school course work (number of years of mathematics, physical science, biological science, computer science, etc.).

Data Sources

Data used in this study were collected as part of the Cooperative Institutional Research Program (CIRP). The CIRP freshman survey program, which is sponsored by the American Council on Education and the Higher Education Research Institute (HERI) at the University of California, Los Angeles, annually collects a broad array of student background information using the Student Information Form (SIF; see Astin, Panos, & Creager, 1966), and is designed to longitudinally assess the impact of college on students. Most of the data for this study are drawn from the 1985 SIF administered to freshmen, the 1989 Follow–up Survey of 1985 Freshmen, and the 1989 Faculty Survey. These instruments can be found in Appendix A. Additional data were obtained from a variety of others sources, including the College Entrance Examination Board, the Educational Testing Service, the Association of Medical Colleges, the American College Testing Program, the U.S. Department of Education, and the National Science Foundation.

The freshman SIF, Follow–up, and Faculty data are ideally suited for undergraduate science pipeline issues. First, the freshman SIF and Follow–up data are longitudinal. This design makes it possible to measure student change and development directly rather than attempting to infer it from cross–sectional data (Feldman & Newcomb, 1969; Stanley & Campbell, 1963). Secondly, these three datasets are multi–institutional. Collecting data from a diverse set of institutions makes it possible to accurately assess institutional effects on student outcomes by representing a wide variation in environmental measures (see Astin, 1970b).

The Student Information Form

The Student Information Form (SIF) was distributed to campuses in the Spring and Summer of 1985 for distribution to college freshmen during orientation programs and in the first few weeks of fall classes. As part of the 1985 freshman survey, the CIRP invited 2,741 institutions to participate. Of these, 546 institutions (20%) accepted and were able to participate. Approximately 200 of these institutions represent the stratified random sample that was originally selected in 1966; repeat participation among this original group is about 90 percent from year to year. Thus 279,985 students at 546 participating colleges and universities completed the SIF.

Survey participants at 181 institutions were excluded from the SIF normative population because of a low rate of return from their college as a whole (usually below 75%). This left 192,453 students at 372 institutions in the national normative population (Astin, Green, Korn, & Schalit, 1985, p. 97). Given our focus on baccalaureate programs in science, we have limited our analyses to four-year colleges and universities. The number of four-year institutions by institutional type that are included in the 1985 CIRP normative population are shown in Table 2.1.

Table 2.1
Distribution of Participating Institutions by Institutional Type, 1985 CIRP Freshman Survey

	Number of Institutions		
Institutional Type	*Population of Institutions*	*CIRP Participants*	*CIRP Normative Population*
Public universities	120	41	27
Private universities	80	33	24
Public four-year colleges	344	64	35
Private nonsectarian colleges	399	146	103
Private denominational colleges	534	170	120
Historically Black colleges	87	19	9
All institutions	*1,564*	*473*	*318*

Note: Adapted from Tables A-1 and A-3, Astin et al., (1985). Four-year colleges and universities only.

The Follow–up Survey

Since 1982, the Higher Education Research Institute has been conducting regular follow–up surveys of entering classes of college freshmen two and four years later. These follow–ups, when linked with freshman SIF data, are designed to assess a wide–range of student experiences and undergraduate achievements and to provide a longitudinal database for studying how different college environments influence student development (see Higher Education Research Institute, 1991).

For each student who was sent a follow–up survey, additional student information was solicited from several other sources. Admissions test scores (SAT or ACT) were provided directly by the Educational Testing Service and the American College Testing Program, respectively. Testing agencies also provided scores for the Graduate Record Exam (GRE) and the Medical College Admission Test (MCAT). In addition, academic information (or "registrar's data") was solicited directly from institutions. Rosters of names of students in the follow–up sample were sent to CIRP institutional representatives requesting the following information on each student: degree earned (if any), number of years completed, and whether the student was still enrolled.

In 1989, three separate samples of students were selected from the 1985 CIRP normative population to be sent the 1989 Follow–up Survey. Since these samples were developed for different purposes, they differ from one another in terms of their sampling design and intended use. These characteristics are described below.

HERI random sample. The first sample of Follow–up Survey data to be used in these analyses is called the 'random sample.' The HERI random sample was drawn using a stratified, random sampling procedure designed to ensure an adequate representation of student respondents from different types of higher education institutions (see Higher Education Research Institute, 1991). Using a stratification scheme that classified institutions by type and selectivity into one of 23 cells, a sample of approximately 17,000 students was drawn from four-year institutions in the CIRP national norms (i.e., those institutions whose response rates to the freshman survey were judged representative of their entering freshman class). This sample size was selected based upon earlier Follow–up Survey response rates and was designed to yield a minimum of 175 respondents in each stratification cell.

The Follow–up Survey instrument was sent to students in late June, 1989. A second wave of Follow–up Surveys was mailed to non–respondents in mid–August, 1989. The response rate to the Follow–up Survey was slightly lower than in previous Follow–up Surveys, averaging some 24% over the random sample of freshmen entering four-year colleges and universities. The lower-than–expected rate can most probably be attributed to (a) the continuing general decline in response rates to mail surveys caused by the arrival of mass–mailing advertising campaigns (see Groves, 1989); and (b) the expansion of the Follow–up Survey form from its typical four–page format to an expanded six–page version. Response rates for the random sample by institutional type can be found in Table 2.2.

Table 2.2
Response Rate by Institutional Type,
1989 Follow-up Survey of 1985 Freshmen, HERI Random Sample

Institutional Type	*Original N*	*Returned N*	*Response Rate*
Public universities	2,824	679	24%
Private universities	2,244	647	29
Public four-year colleges	2,763	615	22
Private nonsectarian colleges	2,777	751	27
Private denominational colleges	4,191	1067	25
Historically black colleges	1,859	157	8
All institutions	*16,658*	*3,916*	*24*

Exxon General Education sample. In undertaking a national study of general education outcomes sponsored by the Exxon Foundation, an additional sample of students was selected to be followed up from the same cohort (i.e., 1985 freshmen). These students attended institutions that were selected to participate in the general education study because of the structure of their undergraduate curriculum.

To assess curricular structure, detailed information was collected from college catalogs and then factor analyzed (see Hurtado, Astin, & Dey, 1991). Using this curricular information, institutions were invited to participate in the general education study because they (a) had a curricular structure that was representative of one of the curricular types identified in the previous study; and (b) had other institutional characteristics (such as size, type, minority enrollment, etc.) that would maximize the variability of institutions in the sample. Using these criteria, 52 institutions were selected for inclusion in the general education project sample.

Updated addresses for the entire cohort of 1985 first–time, full–time freshmen attending these institutions were provided by campus registrars at institutions. Institutions also provided an institutional cover letter (typically signed by the President, Chancellor, or Chief Academic Officer at that institution) that encouraged students to respond. Students in the Exxon sample were sent surveys on the same two–wave schedule outlined above. A limited third–wave of questionnaires was sent to (a) all minority non–respondents; and (b) non–responding students attending institutions whose average response rate was below 25%. Table 2.3 shows student response rates for the Exxon general education sample.

Table 2.3
Response Rate by Institutional Type, 1989 Follow-up of 1985 Freshmen, Exxon General Education Sample

Institutional Type	*Number of Institutions*	*Original Sample*	*Number of Respondents*	*Percent Returned*
Public universities	8	17,402	4,768	27
Private universities	4	3,654	1,537	42
Public four-year colleges	4	1,878	459	24
Private nonsectarian colleges	15	5,464	2,195	40
Private denominational colleges	18	4,501	1,546	34
Historically black colleges	3	1,424	299	21
All institutions	*52*	*34,323*	*10,804*	*31*

NSF Sample Supplement. In the Fall of 1989, HERI was awarded a grant from the National Science Foundation (NSF) to perform a large scale evaluation of undergraduate science education in the United States. Specifically, NSF provided funds with which to supplement the Exxon Foundation sample. The NSF sample supplement was primarily designed to add about 100 institutions to the Exxon–sponsored general education sample to correct for an underrepresentation of certain types of institutions (most notably, public four–year institutions) in the Exxon sample. Within each institutional type grouping (e.g., private universities), approximately equal numbers of institutions were selected for each selectivity level. Table 2.4 shows the distribution of institutions in the CIRP, Exxon, and NSF samples.

Table 2.4
Institutional Characteristics of the CIRP Freshman, Exxon Follow-up, and NSF Follow-up Survey Samples

		1989 Follow-Up Survey		
Institutional Type	1985 CIRP Norm Population	Exxon Sample	NSF Sample	Combined Samples
Public universities	27	8	11	17
Private universities	24	4	17	21
Public four-year colleges	35	4	15	19
Private nonsectarian colleges	103	15	18	33
Private denominational colleges	120	18	34	52
Historically Black colleges	9	3	5	8
All institutions	*318*	*52*	*100*	*152*

Using the permanent home addresses provided by the students upon entry into college in 1985, two waves of surveys were mailed to students attending institutions in the NSF sample in January and March, 1990. In addition, postcards encouraging the students to respond to the survey were mailed immediately prior to the distribution of each survey wave. Table 2.5 shows the response rate, by institutional type, for students in the NSF sample. Despite the lack of updated addresses and institutional cover letter, the response rates are quite similar to those found in the Exxon sample, with the exception of students at historically black colleges (see Table 2.3).

Table 2.5
Response Rate by Institutional Type, 1989 Follow-up of 1985 Freshmen, National Science Foundation Sample

Institutional Type	*Number of Institutions*	*Original Sample*	*Number of Respondents*	*Percent Returned*
Public universities	9	7,343	2,164	29
Private universities	17	11,738	3,875	33
Public four-year colleges	15	9,503	2,853	30
Private nonsectarian colleges	18	7,371	2,387	32
Private denominational colleges	34	5,275	1,579	30
Historically black colleges	5	1,252	144	12
All institutions	*98*	*42,482*	*13,002*	*31*

The Faculty Survey

The Exxon general education project and the NSF project also included a faculty survey component (an overview of the faculty survey project is found in Astin, Korn, & Dey, 1991). For the institutions in the Exxon sample, the chief executive officer (or other high–ranking administrator) at each institution wrote a cover letter to the survey encouraging response, and the institution provided HERI with a current, up–to–date list of faculty addresses (surveys for faculty at NSF institutions were mailed directly by HERI using addresses provided by a commercial vendor of faculty mailing lists). For the Exxon project, participating institutions mailed a HERI Faculty Survey form to all faculty in late October, 1989. A second wave of Faculty Survey forms was sent to non–respondents in mid–December. For faculty at NSF sample institutions, HERI obtained addresses from a commercial vendor and mailed two waves of surveys directly to faculty in January and March, 1990.

Of the 93,479 surveys mailed out, usable returns were eventually received from 51,574 after two waves of mailing, a response rate of 55 percent. Table 2.6 shows this distribution of four–year institutions participating in the faculty survey, while response rates by institutional type are shown in Table 2.7. A comparison of the HERI data and data from a national faculty survey conducted in 1988 by the National Center for Education Statistics (NCES, 1990) suggests that the HERI sample adequately represents the teaching faculty in terms of age, race, academic rank, and highest degree held (see Appendix A in Astin, Korn, & Dey, 1991).

Table 2.6
Distribution of Participating Institutions by Institutional Type, 1989 Faculty Survey

	Number of Institutions		
Institutional Type	*Population of Institutions*	*CIRP Participants*	*CIRP Normative Population*
Public universities	117	28	23
Private universities	69	13	11
Public four-year colleges	347	68	60
Private nonsectarian colleges	375	83	73
Private denominational colleges	507	120	117
Historically Black colleges	86	23	17
All institutions	*1,501*	*335*	*301*

Note: Adapted from Table 1, Astin, Korn, and Dey (1991). Four-year colleges and universities only.

Table 2.7
Response Rate by Institutional Type, 1989 Faculty Survey

Institutional Type	*Number of Institutions*	*Original Sample*	*Number of Respondents*	*Percent Returned*
Public universities	23	28,934	14,119	48
Private universities	11	7,501	3,722	49
Public four-year colleges	60	18,989	10,589	55
Private nonsectarian colleges	73	11,715	6,684	57
Private denominational colleges	117	11,815	8,004	67
Historically black colleges	17	2,840	1,153	40
All institutions	*301*	81,794	44,271	55

Additional Data Sources

In addition to the new data collection efforts described above, data from existing sources were also gathered in order to generate the richest possible dataset. Selected institutional characteristics were gathered from files maintained by HERI, including data originally provided by the Integrated Postsecondary Education Data System (IPEDS), the National Science Foundation data on support to higher education institutions (NSF, 1990), as well as data on collegiate costs and expenses. Curricular information was collected as part of the Exxon–sponsored project on general education outcomes (Hurtado, Astin, & Dey, 1991, provides an overview of the collection and analysis of these curricular data).

Additional student information was solicited from several other sources. Test scores were provided directly by testing agencies. It should be noted that the algorithms used to match CIRP data with varied from agency to agency (some simply used SSN matching, while others also did matching on name and demographic characteristics).

Academic retention information (or "registrar's data") was solicited directly from institutions. Rosters of names of students in the follow–up sample were sent to CIRP institutional representatives requesting the following information on each student: degree earned (if any), number of years completed, and whether the student was still enrolled.

Dataset Characteristics

After completing the data collection procedures, the information obtained from the various sources described above was merged in order to facilitate subsequent analyses. Please note that data from the faculty survey were used in two ways: (1) on the individual level, in order to study the faculty *per se*, and (2) aggregated to the institutional level, in order to study the impact of faculty on the undergraduate science pipeline.

Table 2.8 shows the characteristics of the merged dataset. The dataset described in Table 2.8 was itself used not for analytical purposes, but rather to generate a variety of analytical subsets with a common format. For the purposes described here, the most important of these subsets are those which included the combined follow–up survey respondent samples (known as 'FUSALL'), an institutionally-balanced file of follow-up survey respondents (known as 'FUSMAX'), and a subset of those cases where we had both SAT (and/or ACT) scores and graduate admission test score such as the GRE or MCAT (contained within a dataset known as 'TESTALL').

Table 2.8
Characteristics of the Merged Student Dataset

	Representation			
	Student		*Institutional*	
Data Group	*N*	*Percent**	*N*	*Percent**
Individual level data				
1985 SIF data	260,670	100	481	100
SAT data	157,483	60	476	99
ACT data	35,437	14	192	40
Follow-up data	26,305	10	390	81
Registrar's data	65,257	25	260	54
GRE data	13,967	5	438	91
LSAT data	10,201	4	423	88
MCAT data	3,574	1	342	71
NTE data	3,734	1	375	78
Institutional level data				
Faculty data	148,909	57	217	45
Curricular data	200,861	77	322	67
College Board data	259,760	100	447	93
Institutional characteristics	260,670	100	481	100

*Using representation in the 1985 SIF data as the baseline.

The FUSALL and FUSMAX Datasets

The FUSALL dataset was originally intended to be the main analytical dataset for this study (See Table 2.9). After carefully reviewing the results of preliminary analyses, we were concerned that the uneven number of cases across institutions might inadvertently cause effects related to specific institutions to masquerade as institutional type effects. As noted above, we surveyed the entire freshman class (as represented in the CIRP data) at each of the institutions in the Exxon and NSF samples. While the mean number of cases per institution was 67.8, one large public university with a relatively high response rate contributed 1,070 cases to the sample (over 4 percent of the total number of cases). To address this, we created a balanced analytical sample which placed a limit on the maximum number of cases a single institution could contribute. Using the FUSALL dataset as a base, cases were randomly subsampled from institutions which contributed more than 1 percent of the total number of cases so that no institution contributed more than 1 percent.

Table 2.9
Characteristics of the 'FUSALL' Dataset

	Representation			
	Student		Institutional	
Data Group	N	Percent*	N	Percent*
Individual level data				
1985 SIF data	27,065	100	388	100
SAT data	18,260	69	373	96
ACT data	4,069	15	112	29
Follow–up data	27,065	100	388	100
Registrar's data	20,485	78	255	66
GRE data	2,744	10	249	64
LSAT data	1,661	6	185	48
MCAT data	659	2	142	37
NTE data	1,265	5	250	64
Institutional level data				
Faculty data	24,331	90	193	50
Curricular data	26,767	99	321	83
College Board data	26,295	100	386	100
Institutional characteristics	27,065	100	388	100

*Using representation in the 1985 SIF data as the baseline.

The resulting dataset (FUSMAX, see Table 2.10) was used for the majority of the analyses that follow. The primary exceptions to this are in crosstabular analyses where institutional sample size is not an issue, and where the analysis requires a maximum number of cases is order to study a small population (e.g., African American students interested in the physical sciences). Table 2.11 provides a comparison of the FUSALL and FUSMAX datasets.

Table 2.10
Characteristics of the 'FUSMAX' Dataset

	Representation			
	Student		*Institutional*	
Data Group	*N*	*Percent**	*N*	*Percent**
Individual level data				
1985 SIF data	18,136	100	388	100
SAT data	13,265	73	373	96
ACT data	3,082	17	111	29
Follow–up data	18,136	100	388	100
Registrar's data	14,074	78	255	66
GRE data	1,897	11	249	64
LSAT data	1,058	6	185	48
MCAT data	434	2	137	35
NTE data	1,082	6	244	63
Institutional level data				
Faculty data	15,522	86	193	50
Curricular data	17,856	99	321	83
College Board data	18,126	100	386	100
Institutional characteristics	18,136	100	388	100

*Using representation in the 1985 SIF data as the baseline.

Table 2.11
Comparison of the FUSALL and FUSMAX Datasets, by Institutional Type

	N of Students		*Mean Institutional N*		*Maximum Institutional N*	
Institutional Type	FUSALL	FUSMAX	FUSALL	FUSMAX	FUSALL	FUSMAX
Public universities	7,467	3,097	191	82	1,070	181
Private universities	5,571	3,368	169	106	595	158
Public four-year colleges	3,864	2,928	74	57	347	166
Private nonsectarian colleges	5,540	4,387	50	41	327	156
Private denominational colleges	4,121	3,887	28	27	212	153
Historically black colleges	502	469	38	36	175	153
All institutions	*27,065*	*18,1386*	*68*	*47*	*1,070*	*181*

The TESTALL Datasets

The TESTALL dataset was created by selecting all cases where we had obtained an SAT score (or had converted an ACT score) and there existed a graduate admission test score. We purposely restricted this subset to only those cases where a pre-test was available (in the form of an SAT score) since we were interested in environmental impact, not just performance. Of primary interest in this study is GRE quantitative performance, although scores also exist on the MCAT and will be analyzed as well (see Chapter 6).

A Final Note on Dataset Characteristics and Analytical Considerations

It should be remembered that the number of cases and relative representation of data groups within any particular dataset only roughly represents the effective sample size of any particular analysis. The analyses described in this report are typically limited to cases where data were available from the follow-up survey, the faculty survey, and the analysis of college catalogs. Given the extremely large number of variables in the analysis, missing values on individual-level independent variables have been imputed to preserve the sample size. The standard imputation method used was mean substitution, although in the case of missing SAT scores an institutional mean (adjusted by race and sex) was imputed. Missing values on direct pre-tests and dependent variables were not imputed, and these cases were deleted listwise from the relevant analyses.

Weighting procedures were employed for some analyses to compensate for survey response bias. Non-response to follow-up questionnaires can present serious problems in terms of questionnaire results, but earlier methodological studies (Astin & Panos, 1969) suggest that, while marginal distributions on certain variables can be seriously biased, relationships among variables are only slightly affected, if at all, by non-response bias. Since this study is focused primarily on relationships among variables, we do not expect that the basic conclusions would be seriously affected by non-response bias.

To understand the weighting procedures used, it is important to realize that we have available extensive data on all students (approximately 288,000), follow-up respondents and non-respondents alike, generated by the freshman survey completed in the fall of 1985. Beyond this, for each student followed up, we obtain information from the institution concerning how many years of undergraduate work the student completed and whether or not the student was awarded a degree. This "registrar's data," together with the freshman survey data, are utilized in a complex weighting scheme designed to compensate for non-response bias. Basically, the freshman survey data and the registrar's data serve as independent variables in a large-scale regression analysis where the dummy variable, responding versus non-responding, is used as the dependent variable. The resulting regression equation, which normally involves 50–60 independent variables selected in a stepwise fashion, includes all freshman or registrar's variables which are significantly related to whether or not the student responds to the follow-up questionnaire. Not surprisingly, whether or not the student completed a degree usually has the largest weight in the regression equation, followed by such things as the student's grade point average in high school and certain socioeconomic background variables. This regression composite can be interpreted roughly as an estimate of the probability that the student will respond to the follow-up questionnaire. By taking the inverse of the regression composite, we can generate a differential weight which can then be applied to the questionnaire data of those students who return the follow-up questionnaire. In effect, this procedure gives the greatest weight to those students who most resemble the non-respondents and the least weight to those who most resemble the respondents. Methodological studies conducted at the Higher Education Research Institute suggest that this procedure compensates for many of the biases affecting the responses to student follow-ups.

CHAPTER 3

Changes in Careers and Majors During the Undergraduate Years

It has long been known that undergraduates frequently change both their major fields of study and their career choices during the college years (Astin, 1977; Astin & Panos, 1969; Feldman & Newcomb, 1969; Pascarella & Terenzini, 1991). Although these changes are by no means random—the "traffic" is heaviest between similar fields (Astin & Panos, 1969)—the "balance of trade" during the undergraduate years results in net losses for some fields and net gains for others. Science, mathematics, and engineering (SME) fields have traditionally been among the largest "losers" during the undergraduate years. Indeed, one of the concerns of the current study is to attempt to understand why SME fields experience losses during the undergraduate years and to devise possible recommendations for reducing some of these losses.

In this chapter we examine in detail the "traffic" between various science and nonscience fields, both for the total longitudinal sample as well as for men and women and members of different ethnic/racial groups.

Definitions

One of the first tasks in this study was to define "science" and "nonscience" choices of major field and career. The freshman and follow-up questionnaires (see Appendix A) include detailed listings of 81 possible major fields of study and 44 possible choices of a career. In order to measure change during the four years, both the freshman and follow-up questionnaires contain exactly the same two lists. In the freshman questionnaire students are asked to give their "probable" major or career/occupation; in the follow-up questionnaire the major question asks for "your current/last field of study" in order to accommodate both those who have completed their undergraduate work as well as those who are still enrolled.

Choice of Major Fields

Since nearly half of the 81 major field options could conceivably be considered as an SME field, some combining of different field choices was deemed necessary in order to generate subsamples of reasonable size and to make the results of the study intelligible. After extensive consultation between NSF and HERI staff, a decision was made to collapse the 81 majors into seven mutually exclusive categories: Biological Science, Physical Science, Engineering, Psychology, Social Science (other than Psychology), Nonscience, and Undecided. (The specific majors included in each of these classifications are given in Appendix B.) For purposes of trend analyses and multivariate analyses (see the ensuing chapters), these fields were combined in several different ways to form eight partially overlapping "SME" fields:

Biological Science
Physical Science
Natural Science (Biological plus Physical Science)
Engineering
Science and Engineering I (Natural Science plus Engineering)
Science and Engineering II (Natural Science, Engineering, Psychology, and other Social Science)
Psychology
Other Social Science

The reason for creating these overlapping classifications is to accommodate various policy concerns. Some policy issues, for example, relate to the broad category traditionally referred to by the "SME" acronym. This classification is represented above by Science and Engineering I. Other policy concerns might relate specifically to Engineering, to Natural Science, and so forth. From a purely research perspective, of course, it is useful to know whether there are any significant interactions related to particular scientific subfields. In the interests of parsimony, one would hope that the results for the finer classifications would be sufficiently redundant to justify the use of the broader classifications. This issue, of course, is basically an empirical matter to be determined by subsequent analyses.

One problem in trying to estimate "change" or "loss" of students from science during the undergraduate years is what to do with dropouts. One option, of course, is simply to ignore the problem and to report whatever choices students give at the time of the follow up. But is it reasonable to conclude that a student who leaves college during the first semester and reports four years later that his "last" major was chemistry is indeed a "science major"? Since practically all employers of "scientists" require at least a Bachelor's degree, and since all graduate schools require the Bachelor's degree as a condition for admittance to graduate study in SME fields, such a student would certainly not qualify for inclusion in the nation's supply of "scientists and engineers." In other words, from the perspective of producing scientists and engineers, the chemistry major who drops out during the first term is just as much a "loss" as is the chemistry major who switches to a journalism major before graduating.

These considerations led to a decision to classify all dropouts as being in "nonscience" fields, regardless of their last choice of a major. A "persister" was defined as any science major who, at the time of the follow up in 1989-90, satisfied one or more of the following conditions: (1) had obtained the Bachelor's degree; (2) had completed four years of undergraduate work and still aspired to a Bachelor's (or higher) degree; or (3) was still enrolled full-time in pursuit of a Bachelor's (or higher) degree. All other students were considered as dropouts.

Table 3.1 shows the percentages of students who were classified into each of the eight mutually exclusive categories of majors in 1985 and 1989-90, separately by sex. As in all previous studies of changes in major, we find a net loss in Natural Science and Engineering fields. That these losses are substantially smaller than what has been found in earlier studies (Astin, 1977; Astin & Panos, 1969) is probably attributable to the fact that these are unweighted data and thereby include a disproportionate number of high-ability students. As will be shown in subsequent chapters, ability is one of the factors that is positively related to maintaining a science major and career choice over time. The net losses from SME fields have also been diminished somewhat by

Table 3.1
Four-Year Changes (1985-1989) in Choice of Undergraduate Major Field of Study By Sex

	Percent Choosing Field Among								
	Men (N=10,592)			Women (N=15,396)			All Students (N=26,306)		
Field of Study	1985	1989	1985-1989	1985	1989	1985-1989	1985	1989	1985-1989
Biological Science	12.1	6.7	-5.4	11.9	6.0	-5.9	11.9	6.2	-5.7
Physical Science	8.4	7.1	-1.3	4.9	3.8	-1.1	6.3	5.2	-1.1
Engineering	19.5	11.3	-8.2	4.2	2.2	-2.0	10.5	6.0	-4.5
Psychology	1.9	2.7	+0.8	6.0	6.8	+0.8	4.3	5.1	+0.8
Social Science	6.8	11.8	+5.0	6.7	9.9	+3.2	6.7	10.7	+4.0
Nonscience	45.7	60.4	+14.7	57.4	71.3	+13.9	52.7	66.8	+14.1
Undecided	5.7	0.0	-5.7	8.9	0.1	-8.8	7.6	0.0	-7.6

the substantial decline in undecided students: many of these students end up choosing science fields by the time of the follow up.

In contrast to Natural Science and Engineering fields, we find a slight gain in the number of Psychology majors and substantial gain in the number of other Social Science majors.

The patterns of change by sex are remarkably similar, although the *proportionate* loss of women from SME fields is somewhat greater. Thus, even though the absolute loss from Engineering is much greater for men (-8.2 percent) than for women (-2.0 percent), the decline for women represents a higher proportion of those originally choosing Engineering than does the decline for men. What this means, in practical terms, is that the underrepresentation of women in SME fields widens during the undergraduate years. A similar gender pattern occurs for Psychology and other Social Sciences: men show proportionately larger increases in preference for these fields than do the women.

The net change in the percentage of students who are classified into each of the partially overlapping categories of science majors is shown in Table 3.2. If we look at the traditional broad category of "SME" as represented by Science and Engineering I, we find a net loss of more than one-third of the students between 1985 and 1989 (from 28.7 percent to 17.4 percent). The net loss of 11.3 percent is cut nearly in half, however, if we include Psychology and the Social Sciences as part of SME (Science and Engineering II).

Table 3.2
Four-Year Changes (1985-1989) in Choice of Combined Undergraduate Major Field of Study

Field of Study	Percent Choosing Field Among All Students (N=26,306) 1985	1989	Change, 1985-1989
Biological Science	11.9	6.2	-5.7
Physical Science	6.3	5.2	-1.1
Natural Science[a]	18.2	11.4	-6.8
Engineering	10.5	6.0	-4.5
Science and Engineering I[b]	28.7	17.4	-11.3
Science and Engineering II[c]	39.7	33.2	-6.5
Psychology	4.3	5.1	+0.8
Other Social Science	6.7	10.7	+4.0

[a] Biological Science and Physical Science
[b] Biological Science, Physical Science, and Engineering
[c] Biological Science, Physical Science, Engineering, Psychology, and Other Social Science

The next question concerns the "traffic" between various science and nonscience fields. There are two ways to look at these trends: from the perspective of where students start, or from the perspective of where they end up. Let us first consider these patterns of change from the perspective of where students start (Table 3.3). Each row in the table represents students whose *freshman* choice falls into one of the seven mutually exclusive major field categories. The percentages in the row indicate how the students' final choices are distributed across the same seven categories. Thus, of the 3,138 students who chose a Biological Science major as entering freshmen, slightly more than one third (36.3 percent) maintained that choice during the four years. Better than two in five of these students (42.5 percent), however, switched to a nonscience field during the undergraduate years. Only about one in 20 (5.4 percent) switched from Biological to Physical Science, and only one in 100 (1.0 percent) switched into Engineering. As would be expected, Physical Science students are five times more likely than Biological Science students are to switch into Engineering (5.0 percent), but about equally likely to switch to a nonscience field (46.2 percent). Engineering students are more likely to maintain their initial choice during the undergraduate years (43.9 percent) than are either Biological and Physical Science majors. They are also slightly less likely to switch into a nonscience field (39.9 percent).

Table 3.3
Changes in Undergraduate Majors Viewed Prospectively: Where Students Ended Up

		Percent Choosing Final (1989) Major In						
Initial (1985) Choice of Major	N	Biological Science	Physical Science	Engineering	Psychology	Social Science	Non-science	Undecided
Biological Science	3,138	36.3	5.4	1.0	6.5	8.3	42.5	0.1
Physical Science	1,665	4.1	35.2	5.0	2.6	6.8	46.2	0.0
Engineering	2,771	1.9	7.6	43.9	1.3	5.2	39.9	0.1
Psychology	1,123	1.3	0.7	0.0	38.7	8.5	50.8	0.0
Social Science	1,762	0.6	0.6	0.4	3.0	49.3	46.2	0.1
Nonscience	13,855	1.9	2.1	1.5	3.1	7.4	84.0	0.0
Undecided	1,992	4.3	4.2	1.1	7.2	15.2	68.0	0.1

Of particular interest in Table 3.3 is the fact that Psychology and Social Science majors are even less likely than nonscience majors to switch into Natural Science or Engineering majors. This lack of "traffic" from Psychology and other Social Sciences, to Engineering and Natural Sciences, raises serious questions about the advisability of combining Psychology and other Social Sciences with Natural Sciences and Engineering. (The regression results reported in the next chapter confirm this concern.)

The other way to view the "traffic" among fields is from the perspective of where students with different final choices came from (Table 3.4). The fact that more than three-fourths (77.7 percent) of students who end up in Engineering also started out in Engineering means that Engineering is relatively unlikely to attract recruits from other fields. What is perhaps most remarkable is that Engineering attracts 13.3 percent of its majors from nonscience fields. Physical Science and Biological Science attract even larger proportions of their majors from nonscience fields (21.6 and 16.4 percent, respectively). Again, neither Biological Science, Physical Science, nor Engineering attracts even as much as two percent of their majors from Psychology and other Social Sciences. When it comes to traffic *among* SME fields, Physical Science appears to depend much more on dropouts from either Biological Science or Engineering than the other way around. This heavy recruitment of dropouts from Biological Science and Engineering may help to explain why the net loss of students from Physical Science is much smaller than the net loss from either

Table 3.4
Changes in Undergraduate Majors Viewed Retrospectively: Where Final (1989) Majors Came From

		Percent Whose Freshman (1985) Major Was In						
Final (1989) Choice of Major	N	Biological Science	Physical Science	Engineering	Psychology	Social Science	Non-science	Undecided
Biological Science	1,638	69.5	4.2	3.2	0.9	0.6	16.4	5.2
Physical Science	1,362	12.4	43.0	15.5	0.6	0.7	21.6	6.2
Engineering	1,567	1.9	5.4	77.7	0.0	0.4	13.3	1.3
Psychology	1,338	15.2	3.2	2.7	32.5	3.9	31.8	10.7
Social Science	2,803	9.3	4.0	5.2	3.4	31.0	36.4	10.8
Nonscience	17,585	7.6	4.4	6.3	3.2	4.6	66.2	7.7
Undecided	13	15.4	0.0	15.4	0.0	7.7	46.2	15.4

Biological Science or Engineering (Table 3.1). *In other words, whereas more than one-fourth* (27.9 percent) of students who end up in Physical Science fields come initially from either Biological Science or Engineering, only 7.4 percent of the Biological Science majors are dropouts from Physical Science or Engineering and only 7.3 percent of the Engineering majors are dropouts from the Natural Sciences. As far as Social Sciences and Psychology are concerned, Biological Science supplies far more recruits (especially to Psychology) than do either the Physical Sciences or Engineering.

Do student preferences for science fields and changes in these preferences vary by race or ethnicity? Table 3.5 shows the results for the Science and Engineering I measure (Biological, Physical Science, and Engineering). As would be expected, Asian students show by far the strongest preference for SME majors: more than half (52.6 percent) choose SME majors at the time of entry to college. Somewhat surprisingly, white students show the lowest level of preference (27.3 percent) as entering freshmen, whereas about one third of the American Indians, Chicanos, and African Americans choose SME majors as entering freshmen.

Changes during the four years after college entry show that Chicanos suffer by far the largest losses, both in absolute and relative terms: only about one third as many Chicanos end up pursuing SME majors in comparison to those who started out with SME majors. Losses among African Americans are greater than 50 percent (from about one third to one-sixth), while losses among American Indians are almost as great. Since white students show much smaller absolute and relative losses during the undergraduate years, the proportion of whites who end up with SME majors is comparable to that of the underrepresented minority groups (American Indians, African Americans, and Chicanos). Although the SME losses among Asian students are, in absolute terms, substantial (nearly 17 percent), Asians actually experience the smallest *relative* loss of all racial groups (-32 percent, compared to -39 percent for whites and about 50 percent for the other groups). Thus, four years after entering college Asians are twice as likely as members of any other racial group to be pursuing SME majors.

Table 3.5
Four-Year Changes (1985-1989) in Preference for Science Majors By Race

Racial Group[b]	N	Percent Choosing Science Majors[a] in 1985	Percent Choosing Science Majors[a] in 1989	Change 1985-89
Asian	1,066	52.6	35.9	-16.7
American Indian	209	34.5	17.7	-16.8
Chicano	428	35.7	13.1	-22.6
African American	1,088	34.2	16.1	-18.1
White	22,896	27.3	16.6	-10.7
All Students	26,306	28.7	17.4	-11.3

[a] Biological science, Physical Science, or Engineering.
[b] Puerto Ricans and "other" race are not shown because of small sample sizes.

Why members of all underrepresented minority groups (especially Chicanos) should experience such large losses of science majors during the undergraduate years is not clear. The regression analyses presented in the next chapter provide at least a partial explanation for these losses.

Career Choice

The students' 1985 and 1989 career choices were combined into four mutually exclusive SME categories as follows:

Engineer
Scientist/College Teacher
Social Scientist/College Teacher
Scientist-Practitioner

The Scientist/College Teacher category includes all students who either checked "scientific researcher" on the list of career choices *or* who checked "college teacher" *and* indicated that their current or most recent major field of study was in some field corresponding to Science and Engineering I (see Table 3.2). The rationale for combining these two career choices is that many students who are planning careers as scientists also plan to work as college or university professors. Given that the career choice question was in a forced-choice format (the students could choose only one among the 44 options), some prospective scientists may well have checked "college teacher" rather than "research scientist." The Social Scientist/College Teacher category included only those students who checked college teacher as their career choice *and* indicated some field of psychology or social science as their current or most recent undergraduate major field.

The Scientist-Practitioner category includes all career choices other than research scientist or college teacher which involve substantial training in the natural sciences at the post-graduate level: physician, dentist, optometrist, pharmacist, clinical psychologist, and veterinarian.

Table 3.6 shows changes in students' preferences for these four categories of career choices plus "nonscientist" and "undecided." Both Engineer and Scientist-Practitioner show substantial net losses during the undergraduate years: fewer than half as many students aspire to these careers in 1989 as in 1985. The large loss of students from the Scientist-Practitioner category is primarily attributable to the fact that many students abandon plans to pursue a medical career during the undergraduate years. Both the Scientist/College Teacher and Social Scientist/College Teacher categories show slight net gains, primarily because the career of college teacher increases in popularity during the undergraduate years. Women show slightly larger absolute and relative losses from the Scientist-Practitioner careers than men do; otherwise proportional changes in interest in scientific careers are very similar for men and women.

Table 3.7 shows the "traffic" among these various SME career choices viewed prospectively: where students ended up as a function of where they started out. About one-third of students who start college with plans to pursue careers either as Engineers, Scientist/College Teachers, or Scientist-Practitioners maintain these choices during the undergraduate years. (The number of students who aspire to careers as college social science teachers is much too small to make reliable generalizations.) Regardless of which SME career they choose as freshmen, the majority switch to nonscience careers during the undergraduate years. Students who drop out are about *three times more likely to switch to Scientist/College Teacher (4.1 percent) than to Scientist-*Practitioner (1.2 percent), whereas those who abandon plans to become

Table 3.6
Four-Year Changes (1985-1989) in Choice of Career By Sex

	Percent Choosing Career Field Among								
	Men (N=10,592)			Women (N=15,396)			All Students (N=26,306)		
Career Choice	1985	1989	1985-1989	1985	1989	1985-1989	1985	1989	1985-1989
Engineer	18.6	8.8	-9.8	4.1	1.9	-2.2	10.0	4.7	-5.3
Scientist/College Teacher	4.1	4.8	+0.7	2.7	2.9	+0.2	3.3	3.7	+0.4
Social Science Teacher	0.0	0.8	+0.8	0.0	0.6	+0.6	0.0	0.7	+0.7
Scientist-Practitioner	11.3	5.9	-5.4	12.2	5.8	-6.4	11.8	5.8	-0.6
Nonscientist	54.8	76.0	+21.2	65.4	83.8	+18.4	61.1	80.7	+19.6
Undecided	11.1	3.7	-7.4	15.6	5.0	-10.6	12.8	4.5	-9.3

Table 3.7
Changes in Career Choice Viewed Prospectively: Where Students Ended Up

		Percent of Whose Final (1989) Career Choice Was					
Initial (1985) Freshman Career Choice	N	Engineer	Scientist/ Teacher	Social Science Teacher	Scientist-Practitioner	Nonscientist	Undecided
Engineer	2,642	35.4	4.1	0.3	1.2	56.9	2.0
Scientist/ College Teacher	859	4.8	33.5	0.8	6.1	51.3	3.5
Social Science College Teacher	9	0.0	0.0	11.1	0.0	66.7	22.2
Scientist-Practitioner	3,089	1.2	6.1	0.8	32.9	55.6	3.4
Nonscientist	16,077	1.1	1.5	0.6	1.6	91.5	3.5
Undecided	3,621	1.3	3.8	0.9	4.2	78.2	11.7

Scientist/College Teacher are slightly more likely to switch to Scientist-Practitioner (6.1 percent) than to Engineer (4.8 percent). Those who abandon plans to become Scientist-Practitioners are five times more likely to switch to Scientist/College Teacher (6.1 percent) than to Engineer (1.2 percent).

Table 3.8 views these same changes retrospectively, that is in terms of where those who ended up in each of the SME careers started out. As is the case with engineering majors (Table 3.4), three-fourths of those who end up pursuing engineering careers started out with the same career choice. About two-thirds of those who end up pursuing careers as Scientist-Practitioners (67.0 percent) started college with similar plans. These figures are in dramatic contrast to those for students who ended up pursuing careers as Scientist/College Teachers: less than one-third (29.8 percent) planned to become Scientist/College Teachers when they started college. During college this career choice recruits substantial numbers of dropouts from most other fields: Scientist-Practitioner (19.5 percent), Engineer (11.2 percent), undecided (14.0 percent), and nonscientist

Table 3.8
Changes in Career Choice Viewed Retrospectively: Where 1989 Expected Careers Came From

Final (1989) Career Choice	N	Percent of Whose Initial (1985) Career Choice Was Engineer	Scientist/ Teacher	Social Science Teacher	Scientist-Practitioner	Nonscientist	Undecided
Engineer	1,243	75.3	3.3	0.0	3.0	14.7	3.7
Scientist/ College Teacher	968	11.2	29.8	0.0	19.5	25.5	14.0
Social Science College Teacher	178	4.5	3.9	0.6	14.0	58.4	18.5
Scientist-Practitioner	1,523	2.2	3.4	0.0	67.0	17.4	10.0
Nonscientist	21,216	7.1	2.1	0.0	8.1	69.3	13.3
Undecided	1,178	4.5	2.5	0.2	8.9	48.0	35.9

(25.5 percent). The Social Scientist/College Teacher category recruits virtually all of its people from these other fields, simply because very few students start college planning to become college social science teachers.

For purposes of multivariate analyses (see the next chapter), the four SME career choices were combined into seven partially overlapping career choice categories:

Engineer
Scientist I (Research Scientist, Statistician, Conservationist/Forester, plus College Teachers with majors in the natural sciences or engineering)
Scientist II (same as Scientist I plus College Teachers with majors in the social sciences)
Scientist or Engineer I (Engineer plus Scientist I)
Scientist or Engineer II (Engineer plus Scientist II)
Scientist or Engineer III (Scientist or Engineer II plus Scientist-Practitioner)
Scientist-Practitioner (Physician, Dentist, Veterinarian, Pharmacist, Optometrist, Clinical Psychologist)

Changes in preferences for each of these seven overlapping categories during the undergraduate years are shown in Table 3.9. Perhaps the most important category is Scientist or Engineer I, since it conforms most closely to what policymakers normally think of as "SME careers." The net loss of students from this category during the undergraduate years is more than one-third.

How do changes in science career choices vary by race/ethnicity? Table 3.10 shows changes by ethnicity in the Scientist or Engineer III career choice category. Chicanos show by far the largest absolute and relative net losses from science during the undergraduate years: only one-third as many Chicanos end up pursuing science-related careers as initially aspire to such careers four years earlier at the time of college entry. These large losses are fueled not only by the substantial defection of Chicanos from Engineering, but also by the large Chicano dropout rate

Table 3.9
Four-Year Changes (1985-1989) in Combined Career Choice

Career Choice	Percent Choosing Career Among All Students (N=23,651) 1985	1989	Change 1985-1989
Engineer	10.0	4.7	-5.3
Scientist I[a]	3.3	3.7	+0.4
Scientist II[b]	3.3	4.4	+1.1
Scientist or Engineer I[c]	13.3	8.4	-4.9
Scientist or Engineer II[d]	13.3	9.1	-4.2
Scientist or Engineer III[e]	25.1	14.9	-10.2
Scientist-Practitioner[f]	11.8	5.8	-6.0

[a] Research scientist, statistician, conservationist/forester, college teachers with majors in the hard sciences

[b] Research scientist, statistician, conservationist/forester, college teachers with majors in the hard sciences and those with majors in the social sciences

[c] Engineers plus a above

[d] Engineers plus b above

[e] Scientist-Practitioner plus d above

[f] Physician, dentist, veterinarian, pharmacist, optometrist, clinical psychologist

from medical careers. Higher proportions of Chicanos than of any other ethnic group initially aspire to careers in medicine, but about two-thirds of these students switch to some other career choice during the undergraduate years.

Asians also show a relatively high net loss of students from science careers in absolute terms (-16.3 percent), but in relative terms Asians experience the smallest net loss (-34.8 percent). Thus, four years after entering college the proportion of Asians pursuing science-related careers is twice as high as the proportion pursuing such careers among other racial/ethnic groups. Whites

Table 3.10
Four-Year Changes (1985-1989) in Expected Careers in Science By Race

Racial Group[a]	N	Percent Choosing Science Careers in 1985	Percent Choosing Science Careers in 1989	Change 1985-89
Asian	1,066	46.8	30.5	-16.3
American Indian	209	28.2	14.9	-13.3
Chicano	428	44.1	14.3	-29.8
African American	1,088	29.9	17.1	-12.8
White	22,896	23.4	14.0	-9.4
All Students	26,306	25.1	14.9	-10.2

[a]Puerto Ricans and "other" races are not shown because of small sample sizes.

show the next-lowest relative loss during the undergraduate years (-40.7 percent), followed by African Americans (-42.8 percent), American Indians (-47.2 percent), and Chicanos (-67.5 percent). As was the case with major fields of study, once again we find a higher net loss of students from science careers among underrepresented ethnic minority groups than among whites and Asians.

Summary

Like all previous studies of undergraduate science education, this analysis reveals a substantial net loss of students from science and engineering (SME) majors and science-related careers during the undergraduate years. The number of biological science majors declines by nearly one-half and the number of engineering majors declines by more than 40 percent during the college years. The net decline in physical science majors is much smaller—less than 20 percent—primarily because the physical sciences recruit many dropouts from engineering and biological science. Inclusion of psychology and social science among "science" majors reduces these SME losses by about one-half, since these fields enjoy net gains in students during the college years.

The "traffic" between psychology/social science and natural science/engineering, however, is minimal.

Losses of students pursuing science-related careers is even greater during the undergraduate years. The numbers of students in the two largest career choice groups, engineer and scientist-practitioner (physicians, dentist, veterinarians, etc.), decline by more than half. Although relatively few students say they plan to become either research scientists or college science teachers, the popularity of this combined career category increases slightly during college (from 3.3 to 3.7 percent of the students). The proportionate losses of men and women from science-related careers are very similar.

Asian American students show a stronger preference for science-related careers than does any other racial/ethnic group, and also experience the smallest proportionate declines in preference for such careers during the undergraduate years. Four years after entering college, Asian American students are twice as likely to be majoring in SME fields or to be pursuing science-related careers as are members of other racial/ethnic groups. Although African American, Chicano, and American Indian freshmen in this sample show more interest in science careers than White freshmen do, they experience greater losses from science careers during the college years.

CHAPTER 4

Factors Affecting Choice of Science Careers and Majors

In this chapter we examine the characteristics of entering college freshmen and their environmental experiences in college that affect their chances of choosing a major or career in a scientific field. The analyses will focus on 15 dichotomous and partially overlapping outcome measures: the eight categories of science majors (Chapter 3; Table 3.2) and the seven categories of science career choices (Chapter 3; Table 3.9).

Method

The analyses of the effects of entering student and college environmental variables on science career and major outcomes was based on the input-environment-outcome (I-E-O) model that has been used in many earlier studies of student development (see Chapter 1 and Astin, 1977, 1993). In the context of this chapter "outcome" refers to the dichotomous measures of career or major field choice (each of the fifteen measures requiring a separate I-E-O analysis), "input" refers to the characteristics of the student at the time of initial entry to the institution in fall 1985, and "environment" refers to the characteristics of the institution attended, the faculty at that institution, and the specific educational programs and experiences of the individual student within the institution. The I-E-O model is designed to deal with the principal methodological problem that plagues virtually all research in the social and behavioral sciences: the partial confounding of inputs and environments. Most "naturalistic" studies of the sort reported here are not able to assign subjects (students) at random to treatments (environmental experiences). Rather, students select their institutions and programs and, to a certain extent, institutions and programs select their students. These correlations ("multicollinearity") between inputs and environments virtually guarantee that student outcomes will differ from one environment to the other, even if the differential effects of those environments is nil. To take a simple example: the probability that a graduating senior will be pursuing an SME career in 1989 is substantially greater if that student initially enrolls at Cal Tech or M.I.T. than at Harvard or Stanford. Such an expectation would apply even if there were no differential "effects" of these two sets of institutions on students' career choices, simply because institutions like M.I.T. and Cal Tech are much more likely to attract students with scientific interests than are institutions like Harvard and Stanford. Thus, unless we take into account the differential propensity of entering college freshmen to pursue particular types of careers, it is very difficult to estimate the true effects of different types of institutions and programs on students' career plans. In other words, since "outcomes" are always influenced to some extent by "inputs," and since inputs are frequently correlated with environmental characteristics, it is important to control for the effects of inputs before attempting to assess the effects of environmental characteristics. The focus of the I-E-O model is thus on the possible effects of environments on outcomes. The environment in this particular study is of particular importance because it includes those aspects of the student's institutional climate and program that can be directly controlled through changes in educational policy and practice. The ultimate purpose of applying the I-E-O model is thus to learn better how to structure educational environments so as to maximize desired student outcomes.

The proper application of the I-E-O model requires longitudinal data, where the three components of the model are separated in time: student inputs are assessed prior to exposure to the environment, and the characteristics of the environment are assessed prior to the assessment of outcomes. As the I-E-O model has been applied in an increasingly diverse variety of research problems, a fourth informational component called "intermediate outcomes" has been added. Intermediate outcomes fall in temporal sequence between environments and the outcome measure of primary interest. An example of an intermediate outcome that might affect the student's ultimate choice of a science career would be working on a professor's research project. Experiences such as this do not qualify as "environmental" variables such as institutional size or selectivity, since they cannot be known or measured at the time of the student's initial entry to the institution. On the other hand, most intermediate outcomes are believed to occur at some point prior to the assessment of the student's outcome performance (in this case, their career or major field choice as expressed in the 1989-90 follow-up survey). However, since there is usually a substantial time lag between the assessment of student input characteristics and the occurrence of intermediate outcomes, causal inferences regarding the effects of intermediate outcomes on the outcome measure of interest must usually be made with a considerable degree of caution.

The I-E-O model organizes the various types of variables into separate "blocks" according to their sequence of occurrence. The model then uses stepwise multiple linear regression analysis to control for the effects of successive blocks of independent variables.[1] Thus, the possible effects of environmental variables are assessed only after the effects of input characteristics are taken into account. Variables within a given block are entered in stepwise fashion until no additional variable is capable of producing a statistically significant reduction in the residual sum of squares. After all of the predictive power of the variables within a given block is exhausted, the analysis moves to the next block to determine if additional variance in the outcome measure can be accounted for on the basis of information contained in variables in that block. For additional details concerning the I-E-O model and related matters (measurement error, the use of dummy variables in the regression, and so on) see Astin (1991).

Independent Variables

The independent variables used in each of the 15 regression analyses were organized into three separate blocks according to their temporal sequencing: student input characteristics, environmental characteristics, and intermediate outcomes. Each of these sets of variables is discussed below.

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[1] Given the dichotomous nature of our outcome measures (majors and careers), one might prefer to use logit or probit analysis instead of ordinary least squares regression. Recent methodological studies conducted by HERI staff, however, show that these alternative methods produce results that are virtually identical to the results generated from linear regression (Dey & Astin, in press). Since regression is a more familiar statistical procedure and since our regression software is much more versatile, we decided to use regression.

Student Input Characteristics

There were two major sources of input data: an extensive questionnaire administered to individual freshmen at the time they matriculated in the fall of 1985 and admissions test scores obtained from the Educational Testing Service (SAT) or American College Testing Program (ACT). Using a sample of 15,000 students for whom both tests were available (Astin, 1991), the equipercentile method was used to convert the ACT scores into equivalent SAT scores. This process basically uses a one-to-one conversion of the ACT Math into the SAT Math score, and generates an estimate of the SAT Verbal score through a composite of the three other ACT subtests.

A number of items selected from the 1985 freshman survey were included in the block of input variables. The basic idea here is to include as many input variables as possible that might affect the student's ultimate choice of a major field of study or career. Note that if any such variable is also related to the student's choice of an institution or program within that institution, it represents a potential source of bias in trying to estimate the effects of different environmental experiences on the student's choices. The most obvious sources of bias, of course, are the student's initial (1985) choice of a career and a major field of study. However, to control as much input bias as possible, we added another 140 input variable covering such diverse factors as the student's socioeconomic background, race/ethnicity aspirations, interests, high school activities and achievements, and values and attitudes. While this is a very large set of input or control variables, the consequent loss of degrees of freedom is a minor problem, given the very large sample size (see below).

Environmental Variables

Environmental measures included both institutional-level and student-level measures. Institutional-level measures included measures of the student's peer group (35 measures), faculty (34 measures), curriculum and general education program (15 measures), and institutional structural characteristics (16 measures). Individual level measures included the student's place of residence, work, and financial aid as determined at the point of entry to college (19 measures). For a complete description of each of these measures see Astin (1991).

The 34 measures of the institution's faculty were scored in two different ways: for all faculty at the institution and again for SME faculty only. The latter option resulted in some loss of students and institutions, since there were not sufficient SME faculty at some of the smaller colleges to provide reliable estimates of faculty characteristics on an institutional level, given the large number of independent variables, a very high confidence level for entry of variables into the regression ($p<.0001$) was used to minimize Type I errors.

Intermediate Outcomes

Intermediate outcomes included 57 measures of the student's involvement with various aspects of the undergraduate experience. These measures are primarily indicative of the quantity and quality of student involvement with academic work (22 measures), faculty (6 measures), the student peer group (14 measures), and other college experiences (15 measures).

Results

Before discussing the specific results for each of the 15 outcome measures, it is important to realize just what is being assessed by each of these measures. Each measure is a dummy variable, meaning simply that the outcome measures can assume only one of two values for any given student: either the student opts for the SME career (or SME major) or the student does not. The basic idea of the I-E-O analysis is to see if it is possible to explain why some students do and others do not opt for SME choices on the 1989-90 follow-up survey. There are basically two ways in which students can end up pursuing an SME career or major: to choose such a major or career as an entering freshman in 1985 and to maintain that choice throughout the undergraduate years (the "persisters"), or to start college with some other choice and to abandon that choice in favor of an SME choice by the time of the 1989-90 follow-up (the "recruits"). By combining both of these populations into a single analysis we are, in effect, assuming that the input and environmental factors that affect persisters and recruits are similar. (Analyses of possible differences between persisters and recruits will be deferred until the next chapter.)

Majors

Biological Science

As would be expected, by far the most powerful predictor of choosing a final major in biological science is the freshman choice of a biological major (R= .46). Thirteen other input characteristics add significantly to the prediction of a final major in biological science, over and above the effects of the freshman choice of biological science. The weights assigned to these input characteristics are quite small, as suggested by the fact that their addition to the regression raises the multiple R to only .48. Students' chances of ending up with a biological science major are increased if they have good grades in high school, took many biological science courses in high school, have high scores on the SAT Math test, are strongly oriented toward sciences, and aspire to one of the following careers: Research Scientist, Scientist-Practitioner, or Farmer/Forester. Students' chances of ending up with a biological science major are reduced if they major initially in psychology or aspire either to write original works or to have administrative responsibility for the work of others.

Only two environmental variables add significantly to the prediction after input variables are controlled, raising the multiple R only to .49. One of these is having financial aid based on academic merit. This finding raises the interesting possibility that more students could be induced to major in science if funds could be made available based upon their academic merit. The other environmental characteristic was a peer group measure: the percent of peers majoring in biological science. In effect, this finding indicates that, the more peers there are who are majoring in biological science, the greater the chance that any individual student will end up pursuing a major in biological science. Clearly, this peer group effect could work in several different ways. Having a lot of peers around who are majoring in biological science may provide a kind of deterrent for students who are contemplating leaving biology for some other field. At the same time, having a lot of peers majoring in biological science could provide a kind of magnet attracting students out of other majors. In this connection, it is interesting to note that the freshman career choice of Scientist-Practitioner produced one of the largest simple correlations (r= .31) with a final choice of a biological science major. Since the Scientist-Practitioner category comprises primarily premedical students, a campus with a high proportion of biological science majors would also tend to have a large proportion of students aspiring to careers in medicine. These common curricular experiences, coupled with the students' shared career interests, may tend to create a strong peer group which helps to sustain students' aspirations for a medical career.

A total of 12 intermediate outcome measures add significantly to the regression equation, raising the multiple R to .55. Two of these measures —the number of science courses taken (large positive weight) and the number of history courses taken (smaller negative weight)— may well be artifacts. That is, students would be more likely to end up taking many science courses and few history courses because they remain in a biological science major or switch to biology from some other major. In other words, these correlates may well be consequences, rather than causes of, students' decision to pursue a biological science major. A similar interpretation could be advanced to explain the presence of several other intermediate outcome variables in the regression equation: hours spent attending classes or labs (positive weight) and having class papers critiqued by instructors and taking writing skills courses (negative weights). Nevertheless, there are several other intermediate outcome variables which provide potentially important clues about how choice of a biological science major might be influenced. For example, working on a professor's research project, assisting faculty in teaching a course, and enrolling in an honor's program all have positive weights in the regression. The possibility that one or more of these experiences might well enhance the student's interest in majoring in biological science is intriguing, in part because these are all variables that can be directly manipulated by faculty. One completely unexpected finding was the positive weight for "took an essay exam." Clearly this is not an artifact, since one would normally expect biological science majors to take fewer essay exams than majors in nonscience fields. The possibility that taking such an exam might generate more feedback from faculty does not appear to be an appropriate explanation, since having class papers critiqued by instructors actually had a negative weight in the regression equation. Clearly, the positive weight for taking essay exams provides interesting material for future research.

Since the percentage of students majoring in science turned out to have significant effects on choosing both science majors and science careers (see below), we became interested in the possibility that these effects might indeed be nonlinear. That is, we speculated about the possibility that the percent of students majoring in various fields might not begin to affect the individual student's decision making until these fields reached a kind of "critical mass." To explore these possibilities, we added an additional block of variables at the very end of each regression on a purely exploratory basis. These additional variables were formed by dividing the percentages of students majoring in various science fields into categories (0%, 1-5%, 6-10%, and so forth). The categories were determined by first inspecting the distribution of each variable. Each category was subsequently "scored" as a separate dummy variable. Each dummy variable, in other words, represents a particular range of percentages of students majoring in various undergraduate fields. Somewhat surprisingly, in the biological science major regression, two of these dummy variables—both measures of the percent of students majoring in physical sciences—were found to have negative weights: 5-8 percent of undergraduates majoring in physical science and 9-16 percent of undergraduate majoring in physical science. The presence of these two variables in the regression equation (following the control of all other input, environmental, and intermediate outcome variables) suggests a nonlinear effect on choosing biology of the percent of peers majoring in physical science. Basically what this suggests is that, if there are substantial numbers of peers majoring in physical science, the individual student's chances of ending up with a biological science major are reduced. What may well be happening here is a kind of competition between science fields, where those campuses with very large (and probably strong) physical science programs lure certain students away from biological science into physical science. As we shall see, similar "competitions" involving other SME fields are suggested in later regressions.

Physical Science

The simple correlation between the 1985 and 1989 choices of a physical science major is only .37. Thirteen other student input characteristics add significantly to the regression, raising the multiple R to .42. Input factors that increase students' chances of pursuing a physical science major include a high score on the SAT Math, being strongly oriented toward science, having a high self-rating on mathematical ability, wanting to make a theoretical contribution to science, having high intellectual self-esteem, aspiring to a scientific research career, being African American, and —somewhat surprisingly— pursuing a career in secondary education. This last variable raises the interesting possibility that an initial choice of a physical science major will be reinforced if the student intends to become a high school science teacher. This finding raises an interesting question: Could it be that science majors will be more inclined to remain in science if they can associate their study of science with a specific career objective? Such a possibility is certainly consistent with the finding noted in the preceding regression that aspiring to a Scientist-Practitioner career adds to the student's chances of ending up in a biological science major.

Entering student characteristics that reduce the student's chances of ending up with a physical science major include a high score on status striving, an interest in writing original works, and a high self-rating on popularity.

Five environmental factors add significantly to the regression equation after the effects of input characteristics are controlled. Most notable among these is the percent of peers majoring in physical sciences, which produces the single strongest environmental effect on choosing a physical science major. Having a grant from the college also adds to the student's chances of ending up with a physical science major. Another positive environmental factor of considerable potential significance is the "Student Orientation" of the faculty: the more student oriented the faculty, the more likely the student is to end up with a physical science major. Pursuing a physical science major is also positively affected by the percent of faculty who are in some field of science, whereas the peer environment factor, outside work, has a negative effect.

A number of intermediate outcome variables also add significantly to the regression, although four of these—the number of math courses and science courses taken (positive effects) and the number of writing skills courses and history courses taken (negative effects)—are in all likelihood artifacts. Nevertheless, several of the same intermediate outcome measures that are positively related to choice of a biological science major also enter the regression for physical science major: assisted faculty in teaching a course, working on a professor's research project, and participating in an honor's program. Positive effects are also associated with tutoring other students. This last variables raises the interesting possibility that a student's interest in science can be reinforced if that student is also afforded an opportunity to teach it to other students. (This same interpretation would be consistent with the positive effect, noted above, of assisting faculty in teaching a course.) Two intermediate outcome measures have negative effects on choosing a major in physical science: participating in group projects for a class and taking multiple choice tests. The meaning of these findings is not clear.

Natural Science

This outcome measure was created simply by determining whether the student ended up with a final major field in either biological of physical science. As would be expected, the independent variables that enter the regression equation represent an amalgamation of the variables that predict the preceding two outcome measures. However, the fact that the combined freshman pretest measure (Natural Science) produces a lower simple correlation with its posttest (r=.44) than does the biological science freshman choice with its posttest (r=.46) suggests that the fit of this particular dependent variable on the independent variables may not be as precise. On the other hand, the fact that the final multiple correlation (R=.60) is larger than the final multiple correlations for either the biological or physical science outcomes (.56 and .49, respectively) suggests that the fit of this outcome measure on the other independent variables may actually be somewhat better. The principal differences in the variables entering the regression for the combined natural science major is in the environment. Two peer group measures carried significant weights: The Scientific

Orientation of the peer group and the percent majoring in biological science. While the Student Orientation of the faculty did not enter the regression, two apparent proxy variables did enter with positive weights: the hours per week spent by faculty in the teaching and advising, and the percentage of education and general revenue spent on student services. The final environmental variable is having financial aid based on academic merit (positive effect). Once again, these findings underscore the importance of the peer group, of having a Student-Oriented faculty, and having financial aid based on merit.

Engineering

Engineering produces the largest pretest-posttest correlation of all majors over the four-year interval (r=.54). Twelve additional input variables raise the multiple correlation to .57. The two other input variables that carry the largest positive weights are aspiring to a career as an engineer and the SAT math score. Other predictors that increase students' chances of having a final major in Engineering include having a father who is an engineer, a high self-rating on mathematical ability, having a strong scientific orientation, high school grades, being Asian-American, and having a high score on status striving. Two input variables carry significant negative weights: Having a low level of academic and career commitment and majoring in biological science. Apparently, freshmen planning to major in biological science are less likely than other non-engineering majors to switch into engineering during the undergraduate years. The reasons for this somewhat unexpected finding are not clear.

The student's decision to major in engineering is influenced by both peers and faculty. As is the case with biological science majors, students are more likely to end up majoring in engineering if a high percentage of their peers are majoring in engineering. The percent majoring in mathematics or statistics also carries a positive weight. An interesting phenomenon occurs with another peer measure, the percent of students majoring in science-related fields (natural science plus engineering). While this peer measure has a substantial positive simple correlation with choosing a final major in engineering (r=.32), this correlation disappears when input variables are controlled and becomes significantly negative when the percentages of students majoring in engineering and in mathematics are controlled. Since all that remains of "science-related" fields after engineering and math are removed is natural science, these results suggest that the student's chances of ending up with a major in engineering are reduced when there is a large number of peers who are majoring in the natural sciences. This finding, which is similar to the result obtained with choosing a career in engineering (see below), indicates that having a substantial natural science program on the campus attracts some students away from engineering. In other words, there appears to be a competition between engineering and the natural sciences when it comes to students' choices of majors.

The percent of peers majoring in engineering proves to have a non-linear effect on choosing a major in engineering, given that one of the dummy variables (having more than 28 percent of the student body majoring in engineering) adds significantly to the regression equation after all other variables have been controlled. Two things could be happening here. First, the peer pressure to remain in engineering (or to switch into engineering from some other field) might be especially intense in those institutions where a very large percent of the student body majors in engineering. It may well be that the engineering students are more segregated from other students in such institutions, perhaps holding most of their classes in separate buildings and possibly even having separate residential facilities. Second, as the percent of students majoring in engineering increases beyond a certain point, there may simply be many fewer major field options available for those engineering students who might be considering switching to some other field.

Two measures of the faculty environment—the percent in science fields and the perceived institutional emphasis on resource acquisition and the enhancement of reputation—have significant positive effects on choosing a major in engineering. The second of these variables is of particular interest, given that the input variable mentioned earlier, status striving, also has a positive effect. Apparently, an environment where both the students and the faculty are concerned with status is conducive to the development of an interest in majoring in engineering. Two faculty measures have negative effects: the degree of perceived stress among faculty colleagues and the number of hours per week spent teaching and advising students. The latter of these two measures is of special significance, given that this same measure has a positive effect on the student's interest in majoring in some field of physical science. Why should the faculty's involvement in teaching and advising students encourage students to major in physical science but discourage them from majoring in engineering? One possibility is that this measure reflects substantial differences between the natural sciences and engineering faculty in the approaches they take to teaching and mentoring students.

Although the size of the institution has a positive simple correlation with choosing a career in engineering (in effect, this means simply that large institutions tend to enroll a higher percentage of engineering majors than small institutions do), institutional size proves to have a negative effect on choosing an engineering major once other input and environmental variables are controlled. One possible interpretation of this finding is that there are many more options for engineering majors to switch into at a large rather than at a small institution.

Most of the involvement measures that add significantly to the prediction of a final major in engineering appear to be artifacts. Thus, students whose final major is engineering are more likely to take a lot of science and math courses, to put in many hours studying and doing homework, and to work on group projects for classes. They are less likely to take essay exams and to take courses in history, writing, or foreign language. One other involvement measure of potential significance, shows a negative effect: hours per week spent working for pay. While it could be argued that engineering students simply have less time to spare for outside work, it might also be the case that the time pressures involved in having an outside job may force some students to abandon the very demanding regimen of an engineering major for a less time consuming major. This is clearly a finding with possible policy significance that merits further investigation.

The special problems associated with many engineerings programs are highlighted in a recent comprehensive analysis of this same data base (Astin, 1993). Majoring in engineering has negative effects on students' satisfaction with faculty, quality of instruction, student life, and the overall college environment. It also has negative effects on a variety of academic outcomes:

undergraduate GPA, completion of the bachelor's degree, graduating with honors, aspirations for graduate study, enrollment in graduate school, and self-reported growth in foreign language skills, writing skills, listening skills, and cultural awareness. While majoring in engineering has positive effects on the GRE quantitative test and on self-reported growth in analytical and problem-solving skills and in job-related skills, it has negative effects on the NTE General Knowledge Test. Majoring in engineering also has negative effects on a number of affective outcomes, including student commitment to promoting racial understanding.

In short, while majoring in engineering enhance a student's quantitative and analytical skills, it produces a number of negative effects on other kinds of cognitive outcomes and on satisfaction with most aspects of the college experience. Clearly, it would appear that some of the problems that engineering programs have in retaining students may be associated with these negative outcomes. Although we cannot be sure what the key factors are that discourage students from persisting in engineering, their dissatisfaction with faculty and with their quality of instruction no doubt play some part.

Science Major 1 (Natural Science plus Engineering)

This conglomerate of major field choices corresponds most closely to what has come to be known as "SME." Of all the outcomes, it produces the largest final multiple correlation (R=.67).[2] Significant input predictors represent a combination of the input predictors summarized for the previous two outcome measures. Positive environmental factors include two peer measures: Scientific Orientation of the peer group and the percent of peers majoring in science-related fields. Positive faculty variables include the percent of faculty in science-related fields and the Student Orientation of the faculty. Having merit based aid is also a positive factor, while attending a public university proves to have a negative impact on this outcome.

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[2] This may well result from the larger "base rate" in this particular dummy variable (i.e., the split is closer to .50), which makes it easier to predict from more continuous variables.

Given that some of the more interesting findings from the separate engineering and science regressions have been obscured in this combined regression, it would appear that a lot of potentially important information is lost when engineering is combined with the sciences.

Science Major 2 (Science Major 1 plus Psychology and Social Science)

This largest "SME" category produces a substantially poorer fit (R=.55) then does the previous outcome measure (R=.67). This fact, together with the finding that the previous outcome measure confounds certain potentially important environmental effects that are revealed in the separate natural science and engineering regressions, led to a decision not to report the detailed findings for this combined category. Rather, to conserve space we shall limit further discussion to the results for separate analyses of psychology and social science (below).

Psychology

This outcome measure produces the poorest fit of all, with a simple pretest-posttest correlation of only .33 and a final multiple R of .40. Input variables adding significantly to the prediction of a final major field choice in psychology (following control of the freshman choice of psychology) include being female, planning on post-graduate education at the time of freshman entry, aspiring to a career as a scientist/practitioner, being undecided about the freshman major, and expecting to change the freshman major. These latter two predictors suggest that psychology recruits a large number of its majors from freshmen who are either undecided or uncertain about their major field choice when they enter college. Two faculty measures appear to encourage the choice of the psychology major: The Humanities Orientation of the faculty and Faculty's Time Stress. Interestingly enough, the use of multiple choice tests by faculty appears to have a negative impact on choosing a career in psychology. Given the heavy reliance of many psychologists on this testing methodology, it is both interesting and ironic that the frequent use of multiple choice tests seems to discourage students from pursuing careers in psychology.

As is the case with natural science and engineering majors, many of the student involvement or intermediate outcome measures that add to the prediction of a final major in psychology appear to be artifacts. For example, positive weights are associated with number of science courses taken, working on an independent research project, taking multiple choice exams, and working on a professor's research project (these two last measures no doubt reflect the tendency of psychology professors to rely on multiple choice tests and to use their students as subjects in their own research). Other involvement measures showing positive weights include enrolling in women's studies courses, receiving personal/psychological counseling, and participating in the volunteer work. Negative involvement variables include number of math/numerical courses taken, number of history courses taken, working on a group project for a class, tutoring other students, and participating in intramural sports.

Social Science

The simple correlation between freshman and follow-up choice of a social science major is .33; the final multiple R is .45. Input measures that add positively to the prediction of a final major in social science include the following: SAT Verbal score, interest in influencing the political structure or in being an expert in finance or commerce, planning a high level degree, being Jewish, having high socioeconomic status, being undecided about both career and major, and expecting to change the freshman major field choice. Negative factors include interest in creating artistic works, freshman choice of an engineering major, and commitment to making a theoretical contribution to science. That this last input measure carries a negative weight is further evidence supporting the argument that social sciences should not be combined with natural science and engineering.

Environmental factors having a positive effect on choosing a final major in social science include three peer measures: Peer Socioeconomic Status, peer Intellectual Self-esteem, and the percent of peers majoring in social science. Students' chances of ending up with a final choice in social science also increases if the student attends college far from home. One faculty measure has a positive effect on choosing a major in social science: The Humanities Orientation. Negative faculty measures include the reliance on multiple choice exams and a positive faculty attitude toward the general educational program. Once again, we find evidence that heavy reliance on multiple choice testing discourages students from choosing a social science major. However, the result concerning the negative effect of faculty attitudes toward the general education program is puzzling.

Most of the involvement measures having significant weights in the final regression equation appear to be artifacts: The largest positive weights are associated with taking essay exams, number of history courses taken, enrolling in ethnic study courses, and enrolling in interdisciplinary courses. Negative weights are associated with number of science courses taken, giving class presentations, hours spent attending classes or labs, and taking multiple choice exams. Positive weights are also associated with discussing racial/ethnic issues and with hours per week spent partying. Other negative weights include hours per week spent on hobbies and hours per week spent watching television.

Career Choice

Given that many potentially important results are likely to be lost when engineering is combined with natural science, or when social sciences are combined with natural science and engineering, we will limit our discussion here to three career outcomes: Engineer, Research Scientist (scientist/college teacher), and Scientist-Practitioner. These are all non-overlapping categories that account for all of the career choice categories discussed in the preceding chapter, with a single exception of those categories that include college teachers from psychology or the social sciences (less than 1 percent of the sample).

Research Scientist

The pretest-posttest correlation involving this career outcome is quite small (r=.28). Other input variables which add to the prediction of a final choice of a Research Scientist career include interest in making a theoretical contribution to science, SAT math score, choosing a freshman major in natural science, having a father who is a research scientist, and having a mother who is a research scientist. Other positive input predictors include giving "preparation for graduate school" as a reason for attending college, commitment to becoming an authority in one's field, interest in obtaining recognition from colleagues, interest in becoming involved in programs to clean up the environment, and being undecided about one's career. Again, this last predictor suggests that the career of Research Scientist recruits a number of initially undecided people during the undergraduate years. Only two input variables enter the regression with negative weights: Social Activism and Status Striving. Since obtaining recognition from colleagues and becoming an authority are part of the Status Striver measure, why should they have positive weights while the Status Striver score has a negative weight? In all likelihood, this seemingly contradictory result occurs because the other components of Status Striving--interest in business and wanting to be very well off financially—are no doubt negative predictors of choosing a career as a research scientist. A similar interpretation would account for the fact that Social Activism predicts negatively, but that one component of Social Activism—interest in becoming involved in cleaning up the environment--has a positive effect. Thus, it would appear that, while Social Activists in general tend not to become Research Scientists, interest in environmental issues as such (a component of Social Activism) tends to be a positive factor in choosing a career in research.

Only two environmental variables appear to have significant effects on choosing a career as a research scientist: having a grant from the college and the use of written evaluations. The first of these two measures has already been observed in regressions for majoring in natural science. The second measure raises some interesting possibilities for speculation. In another large scale study using this same data base (Astin, 1993), the use of written evaluations had a positive effect on careers both in research and in college teaching (both components of the current measure). Although only 4% of the student sample used in this analysis attended colleges where written evaluations of student performance are used, this pedagogical approach appears to offer some promise as a technique for recruiting more students into science careers. In all likelihood, the effect is related to the fact that, in order to write a coherent student evaluation, a professor ordinarily needs to become closely acquainted with the student's work. Thus, the use of written evaluations may create stronger bonds between the professor and the student because (a) students perceive their professors as taking a personal interest in their academic development and (b) professors get to know the students better. As a consequence, teachers may come to be perceived as positive role models that the student subsequently emulates by deciding to pursue a career either in science or in college teaching.

As was the case with major field choices, the career choice of Research Scientist is substantially correlated with a number of intermediate outcomes or involvement measures that appear to be primarily artifacts. There are, nevertheless, some interesting involvement measures that might indeed represent possible ways of increasing student's interest in science careers. Thus, we find positive partial correlations with talking with faculty outside of class, assisting faculty in teaching a course, working on an independent research project, and working on a professor's research projects. While it is possible to argue that some or all of these variables are outcomes of choosing a science career rather than causes of that choice, the possibility remains that some of these experiences may indeed reinforce the student's interest in science.

Engineering

The regression analysis for choosing a career in engineering produces results that are very similar to the results obtained in the analysis of engineering majors. The simple pretest-posttest correlation involving this choice is .49; the final multiple R is .56. Other input variables that add significantly to the prediction of a career choice in engineering include the student's SAT math score, self-rating on mathematical ability, Scientific Orientation, being a male, having a father who is an engineer, high school grades, and choosing a freshman major either in engineering or in some vocational/technical field. Students are also more likely to end up choosing a career in engineering if they give "parent's desires" as an important reason for their decision to go to college. Negative input predictors include giving "to become a more cultured person" as a reason for attending college and choosing an initial major in biological science.

A number of peer factors turn out to have positive effects on choice of an engineering career. By far the strongest factor is the percent of peers majoring in engineering. The percent majoring in math/statistics also has a small positive weight. However, the percent of peers majoring in physical science proves to have a negative effect on choosing an engineering career, a finding which, once again, reinforces the earlier interpretation that there is in certain institutions competition for students between engineering and the physical sciences. Both the percent of students majoring in physical sciences and the percent majoring in engineering also have non-linear effects. Thus, the dummy variables representing the highest categories of these measures (over 16% majoring in physical science and over 28% majoring in engineering) both contribute significantly to the regression after all other variables had been controlled. Again, it would appear that the effects of these two peer measures depend to a certain extent on reaching a "critical mass" in terms of students in either physical sciences or engineering.

Three other environmental variables produce negative effects on choosing a career in engineering: offering women's or gender studies courses, having a student body comprising more than 80% men, and institutional size. These last two environmental variables have positive simple correlations, but the coefficients become negative after other input and environmental variables are controlled. Why students should be less likely to end up pursuing engineering careers when they attend institutions with a very high percentage of men is not immediately clear. One possibility is that this is an artifact created by the presence of several military academies in our sample. All of these institutions enroll more than 80% men, and very high percentages of their students also major in engineering. However, relatively few graduates of military academies plan careers as engineers. Thus, even though many of their undergraduates major in engineering, most are probably not pursuing careers as engineers. Rather, they are most likely planning careers either in the military or, once they complete their obligatory military service, in some civilian occupations other than engineering. This interpretation is consistent with the finding that having more than 80 percent men did not affect choice of an engineering major.

Among the several involvement variables entering the regression, all appear to be artifacts with one possible exception: the positive effect of hours per week spent studying or doing homework.

Scientist-Practitioner

The pretest-posttest correlation involving the Science-Practitioner career is .42. The final multiple R is .51. Other entering characteristics which are positively related in choosing a career as a Scientist-Practitioner include high school grades, SAT math score, highest degree aspired to, choosing a freshman major in biological science, and having a father who is a doctor. Input variables with negative weights include being white and choosing a freshman major in either business or social science.

Only two environmental variables add significantly to the prediction of this career choice, and both have positive weights: positive faculty attitudes about the general education program and the percent of Jewish students in the student body. This latter measure may well represent a proxy for the percent of students pursuing careers in medicine (Astin, 1993).

As has been the case with other major and career outcomes, most of the involvement or intermediate outcome measures can be explained as artifacts of the student's final choice. The only possible exceptions are the positive weights associated with the hours per week spent in volunteer work and working on a professor's research project. It is of particular interest that the student's undergraduate GPA also carries a significant positive weight in the final regression. This effect may well reflect the heavy weight given to the applicant's undergraduate grades in the admissions policies of most medical/dental/veterinarian schools. It may well be that those students who get relatively poor undergraduate GPAs subsequently abandon plans to pursue careers in these highly selective fields.

Summary and Discussion

The regression results reported in this chapter will be discussed separately under two major headings: input factors and environmental factors.

Input Factors

One of the most consistent and potentially important patterns of input effects concerns measures of student achievement and ability. Table 4.1 summarizes the effects of three such measures: SAT Math, SAT Verbal, and high school grade point average (GPA). As it turns out, the student's score on the SAT Mathematics test is a significant predictor of every SME career choice or major field choice except the social science major (in this instance, the SAT Verbal carries a significant predictive weight). The final Beta coefficients shown in Table 4.1 are substantially smaller than the simple correlations, primarily because the freshman career and major field choices have also been controlled. In other words, the ability and achievement variables shown in Table 4.1 have both direct and indirect effects on students' career and major field choices. The direct effects are shown under the "Beta" columns, which represent the residual effect of the ability or achievement measure after the effects of all other independent variables (including freshman choices) have been controlled. In path analytical terms, the simple correlations are larger in part because ability also affects the final career and major field choices indirectly through its effects on the freshman career and major field choices. Thus, most of the shrinkage that occurs between the simple correlation and final Beta occurs when the freshman career and major field choices are controlled. Another implication of these results is that ability and achievement continue to affect students' decisions about studying science and pursuing a science career for sometime after they leave high school.

Table 4.1
The Effects of Academic Ability on Choice of Science Majors or Careers During The College Years

	SAT Math		SAT Verbal		High School GPA	
Final Choice	r	Beta	r	Beta*	r	Beta*
Major						
Biological Science	.10	.04			.13	.06
Physical Science	.16	.05				
Engineering	.22	.08			.13	.04
Science & Engineering I	.30	.09			.23	.08
Social Science			.15	.08		
Career						
Engineer	.17	.03			.11	.04
Research Scientist	.12	.06				
Scientist/Practitioner	.09	.04			.11	.05

*After freshman choice and after input and environmental variables are controlled.
Note: All coefficients are statistically significant (p<.0001)

These direct and indirect effects of ability and achievement on the student's interests in studying science in college and in pursuing a scientific career after college have important implications for future science education policy. For one thing, they suggest that the number of students pursuing science majors and careers at the point of college entry and at the completion of college could be increased if the overall level of mathematical competency in the high school population could also be increased. The independent positive effects of the student's high school grades suggest that these numbers could also be increased if the overall level of academic achievement of students could be increased at the secondary level.

Another consistent pattern of input effects concerns the occupations of students' parents. (Table 4.2). As it turns out, all three career choices for which regression results are reported in this chapter—engineer, scientist, scientist-practitioner—are positively influenced by having one or both parents in the same career (by "same" we refer to the fact that the scientist-practitioner category comprises primarily students pursuing careers as physicians).

Table 4.2
"Occupational Inheritance" in the Choice of a Science Career

Student Career	Parental Career	Simple r	Final Beta
Engineer	Father: Engineer	.09	.03
Research Scientist	Father: Research Scientist	.06	.03
	Mother: Research Scientist	.07	.05
Scientist-Practitioner	Father: Physician	.12	.06

Note: All coefficients are statistically significant (p.<0001).

When it comes to the student's race and socioeconomic status, there are only a few scattered findings. Being Asian contributes positively to choosing a final major in engineering, whereas being white is a negative predictor of choosing a career as a scientist-practitioner. Socioeconomic status is a positive predictor of choosing a major in social science and a negative predictor of choosing a career as an engineer. Otherwise, race and socioeconomic status do not contribute to the prediction of any career or major field choices.

The student's sex turns out to be a significant predictor of only three outcomes: psychology major (being a woman is a positive predictor), and engineering major and career (being a man is a positive predictor of both). In short, while psychology enjoys a net gain in the proportion of women majors during undergraduate years, engineering experiences a net loss. Since the sex variable maintains a significant Beta throughout these three regressions, these sex effects cannot be entirely attributable to other variables such as ability, achievement, freshman choices, socioeconomic status, or race.

Environmental Factors

The clearest and most consistent pattern of environmental effects on student choice outcomes is associated with the concentration of peers in various fields of study. Basically, the greater the proportion of peers majoring in a particular SME field, the greater the likelihood that any given student will end up choosing a career in that same field. Table 4.3 shows the results for the four principal categories of majors: biological science, physical science, engineering, and social science. The percentage of students majoring in engineering also has a positive effect on the student's choice of an engineering career. For at least three of these outcomes—physical science major, engineering major, and engineering career—the effect is nonlinear, with the curve accelerating at the higher end of the distribution of relevant majors.

These environmental effects are similar in character to a wide range of peer group effects on other outcomes identified in a recent study using the same data base (Astin, 1993). Basically, the general principal to be derived from these empirical findings can be stated rather simply: during the undergraduate years, individual students tend to become more like their peers. This finding suggests a very practical question that needs further exploration: who, in fact, are any given

Table 4.3
Effects of Peer Interests on Student's Final Choice of Major

(Outcome) Student's Final Major	(Environment) Percent of Peers Majoring in	r	Beta after Input[a]	Beta after Final[b]
Biological Science	Biological Science	.12	.04	.04
Physical Science	Physical Science	.14	.09	.08
Engineering	Engineering	.34	.13	.17
Social Science	Social Science	.25	.15	.12

[a] After initial choice of major, career choice, and other entering freshman characteristics have been controlled.
[b] After entering freshman characteristics and all other environmental variables have been controlled.

Note: All coefficients are statistically significant ($p<.0001$)

student's "peers"? In these analyses this question has been answered somewhat simplistically: "all other members of the student's entering freshman class." However, the fact is that each student, to a certain extent, selects his or her own associates and peers within any new class of entering students. In other words, students do not associate at random with fellow students. Indeed, the non-linear effects of some of these peer measures suggests that, as the number or proportion of peers majoring in a particular field increases, the probability that any individual student majoring in the same field will associate primarily or exclusively with students majoring in that field increases exponentially. A physics major attending a small college may affiliate primarily with nonscience majors, but a physics major attending a technologically oriented university may well affiliate primarily with other natural science majors.

There may also be structural features of certain institutions that facilitate or encourage affiliation among peers in the same major. For example, in those institutions with very large engineering programs, the engineering majors may be physically segregated from other students in a separate "school" or large department. They may even live in similar sections of residence halls and socialize and study together. Under these conditions, students who are entertaining second thoughts about the wisdom of majoring in engineering might be subjected to substantial peer pressure to remain in engineering. By contrast, an engineering major who affiliates primarily with students majoring in liberal arts fields might receive strong peer support for changing to some other support for changing to some other major. One way to test these interpretations would be to determine if the non-linear effect of the percent of peers in engineering is stronger for students who initially choose an engineering major (persisters) than for students who initially choose some other major ("recruits"). Such a possibility will be explored in the next chapter, when "persisters" and "recruits" are studied separately.

The fact that the concentration of students in various majors does not have the same clear-cut impact on the careers of Research Scientist and Scientist-Practitioner may well reflect the absence of parallel peer group measures. That is, we did not incorporate measures such as the proportion of students planning to become Scientist-Practitioners or the proportion planning to become Research Scientists.

The findings also suggests that there may be significant interdepartmental competition for majors among certain SME fields, especially between engineering and the physical sciences. Thus, in the analyses of both engineering majors and engineering careers, the student's choice was negatively affected by the percentage of peers majoring in the physical sciences. Again, these effects are non-linear, such that the largest effect occurs in those institutions with the highest percentage of peers majoring in physical sciences. Why should students be less likely to end up pursuing a career in engineering if they happen to attend a college where many student peers are studying some field of physical science? One possible explanation concerns the status differences that one typically encounters among the different scientific fields. Within the broad field of science and engineering, engineering is often regarded as having lower status because it is an "applied" or "professional" field, rather than a "pure" or "academic" discipline. It may well be that, when an institution simultaneously operates an engineering program and a large undergraduate program in the physical sciences, many students are tempted to leave engineering in order to enroll in the more prestigious physical science fields.

The competitive effects of the proportion of peers majoring in engineering and the proportion majoring in physical science is shown in Table 4.4. Among the 1,376 students in our sample who started college in 1985 intending to pursue a career in engineering, 36% still planned on being engineers four years later. However, among freshman engineering students who enrolled in colleges with the highest percentage of peers majoring in the physical sciences (more than 16%), only 13% were still pursuing engineering careers in 1989. A similar negative (and non-linear) effect of the concentration of students in physical science majors was observed in the analysis of biological science majors.

There seem to be several possible policy implications of these findings. First of all, it would appear that the numbers of students who end up pursuing particular science majors and science careers would be increased if SME students could be isolated from their peers in other fields.

Table 4.4
Effect of Peer Interests in Science and Engineering on Choice of an Engineering Career
(N=1,370 Freshmen Intending to Become Engineers in 1985)

		Percent Pursuing Engineering Careers in 1989 Among Students Enrolling at Institutions Where the Percent of Peers Majoring in Physical Science Fields is			
Percent of Peers Majoring in Engineering	N	less than 5 percent	5-16 percent	over 16 percent	Total Sample
More than 28	259	46	53	13	40
17-28	541	42	43	*	42
1-16	391	33	36	*	33
Less than 1	179	17	13	*	15

* Sample size too small to compute reliable percents.

Whether such a policy would be desirable from the larger perspective of the institution's educational mission or goals, or whether it would be desirable from the point of view of the students' overall educational experience, is beyond the scope of this discussion. Another implication is that the number of students pursuing engineering majors and careers could be increased if the engineering programs could be located in institutions with relatively small physical science programs or somehow isolated from the physical science programs. Again, whether such a policy would be desirable with respect to other institutional goals and objectives is questionable.

Another interesting pattern of environmental effects concerns student-faculty interaction and student-student interaction. Frequent interaction between students and faculty has a positive effect on all SME outcomes except engineering majors and engineering careers. The most plausible interpretation of these effects is in terms of role modeling: Students will be more likely to see their science teachers as potential role models if they frequently interact with them.

Why student-faculty interaction does not also have a positive effect on choosing a major or career in engineering is not immediately clear. One possibility relates to the general climate that students encounter in the typical engineering programs (see the earlier discussion under Engineering Majors). Analyses reported in Chapter 9 indicate that engineering instructors are less likely to use active learning techniques. Or perhaps of greater relevance is the fact that students in engineering programs tend to be less satisfied with their faculty and less satisfied with the quality of instruction than are students in other majors. Thus, the greater interaction with faculty may not have the same positive effect on engineering students simply because these interactions are less likely to be perceived as favorable.

Another set of findings with possible policy significance is the positive effects of participation in honors programs on all SME outcomes except engineering careers and majors. Honors programs, which also have a number of positive effects on other developmental outcomes (Astin, 1977; Astin, 1993), may well work through the mechanism of student "involvement." In other words, honors programs may elicit greater involvement from students by immersing them in the subject matter of their major. Honors programs may also be effective because they stimulate greater peer interaction within particular fields of study.

Still another set of findings with possible policy significance concerns the effects of work. Having a part-time job on campus appears to increase the student's chances of ending up majoring in some field of natural science. However, off-campus employment has negative effects on three SME outcomes: majoring in Physical Science, majoring in Engineering, and choosing a career as a Research Scientist.

Still other variables that may help to strengthen the student's interest in science are participating in professors' research projects, assisting faculty in teaching courses, participating in independent research projects, and tutoring other students. While the possibility remains that some of these activities are the result rather than the cause of the student's final decision to major in science or pursue a science career, it may well be worth conducting some small-scale experiments to determine if such activities can indeed be effective in promoting the student's interest in science.

CHAPTER 5

Persistence in, Defection from, and Recruitment into Sciences and Engineering

Chapter 4 examined the personal characteristics of students as well as their college experiences that resulted in their choosing to major in the sciences or in engineering and in their career aspirations for such fields.

In this chapter we examine what differentiates those students who persist in scientific and engineering majors and careers from those who defect. We also examine what kinds of college experiences encourage students to shift from other areas into engineering and/or science, in other words, to become recruits to SME fields. We define persisters as those students who hold the same SME major or career aspiration at entry into college (1985) and four years later (1989). Students who change their major or career from an SME field to social science, psychology or a nonscience field between 1985 and 1989 are labeled defectors, and those who shift into an SME field from a non-SME choice constitute the recruits.

Analyses were performed for three major field and three career aspirations. The majors include: engineering, biological sciences, and physical sciences. The careers include: engineer, scientist, and scientist/practitioner. (For details of specific fields included under each major category, see appendix B).

Regression analyses followed the same pattern outlined in the methodology and in Chapter 4. For each major and each career, two sets of analyses were performed. First an analysis was done to differentiate persisters from defectors. A second analysis was done to identify predictors that differentiated recruits into the sciences from students who remained in nonscience fields.

These analyses were first run for the total sample for each major field or career category. However, separate analyses for men and women were performed if gender entered the regression equation as a predictor of an outcome in the total sample.

Each regression analysis is preceded by some descriptive statistics about the patterns of stability and change within the specific career or major category.

PHYSICAL SCIENCE MAJORS

Patterns of Stability and Change

This section examines similarities and differences among physical science majors who persisted in, defected from, and were recruited into the physical sciences. Of the three science major fields (physical sciences, biological sciences, and engineering) discussed in this section of the report, the physical sciences were the least popular among entering students. While the net loss of physical science majors was smaller than for other science fields, there was still an "outflow" from majors in the physical sciences from the time that students first entered college in 1985 until four years later (see Table 5.1). Women were only half as likely as men were to report an initial interest in majors in the physical sciences.

Table 5.1
Percent Choosing Physical Science Majors: 1985-1989

		Percent		Percent Change
	N	1985	1989	1985-1989
All Students	26,306	6.3	5.2	-1.1
Men	10,592	8.4	7.1	-1.3
Women	15,396	4.9	3.8	-1.1

The descriptive data shown in Table 5.1 include all students for whom we had longitudinal data. (This "maximum" sample was also used in the descriptive analyses reported in Chapter 3.) Subsequent analyses of physical science majors reported below use the more restricted sample, with no institution contributing more than one percent of the cases. For this reason, the aggregate figures from these multivariate analyses may deviate slightly from the data shown in Table 5.1.

In order to get a clearer picture of movement into and out of the physical sciences, it is important to track the movement of students who defected from a major in physical sciences as well as those students who were recruited into majors in the physical sciences. Nearly 56 percent of those students who entered college in 1985 majoring in the physical sciences changed to majors outside of the physical sciences sometime during their four years of college. Hence, it is important to understand to which fields this science talent was lost. Table 5.2 shows the highest ranking major fields of study which attracted those students who left study in the physical sciences during college.

Table 5.2
Seven Top Major Field Choices for Defectors from the Physical Sciences
(N=604)

Major field	Percentage
Business	19.2
Social Sciences	16.9
Engineering	12.0
Education	8.7
History/Political Science	8.3
Other Technical Fields	8.1
Biological Sciences	7.4

Business fields drew the largest number of defectors from the physical sciences. Upon examination of the entering characteristics of students who defected from the physical sciences (see below), this finding is not surprising. These students had attributes and attitudes at the time of college entry which suggested that they might move in that direction. Not all of the students who defected from the physical sciences were lost totally from the science pipeline. Rather, their interests shifted to other science and science-related disciplines. Nearly 20 percent of students who left the physical sciences moved into the fields of engineering and biological sciences.

The "inflow" of students to the physical sciences nearly equaled the "outflow" of students from the physical sciences. It is important that we understand from which fields students come who were recruited into study in the physical sciences. This may provide information for the short-term as to where we might look to fill the "gaps" in the pipeline created by students who defect from study in the physical sciences. The highest ranking major fields which supplied recruits to the physical sciences are presented in Table 5.3.

Table 5.3
Six Top Initial Major Field Choices for Students Recruited to Physical Sciences
(N=623)

Major field	Percentage
Engineering	30.8
Health-related fields	14.3
Other Technical fields	12.0
Undecided	11.0
Business	8.1
Biological Sciences	7.9

As can be seen from the figures reported in Table 5.3, the majority of students who are recruited into the physical sciences come from other science and science-related fields. Also included in the group of recruits is a sizable percentage of students who entered college with an interest in and aptitude for science study, but were undecided at the time they entered college as to precisely what area they wanted to concentrate their studies. While the majority of students who defected from study in the physical sciences moved into nonscience fields, most students who moved into the physical sciences were recruited from other science and science-related fields.

Given that the three most common freshman fields for recruits are all science-related (engineering, health, technical), it is reasonable to assume that many of the initially undecided students were also science-oriented, but simply undecided on a specific major. By also adding freshman biology majors, we end up with about 70-75% of physical science recruits coming from freshman choices that were science-related. These facts underscore the fact that science is largely a one-way street during the undergraduate years, with substantial numbers of defectors and relatively few recruits coming from nonscience fields.

Descriptive Characteristics of Persisters, Defectors, and Recruits

Some clear patterns emerged from the descriptive data regarding the pre-college characteristics of students who began and/or ended as majors in the physical sciences. Persisters and recruits both tended to report higher high school grades than did defectors. In addition, both persisters and recruits, in comparison to students who defected from the physical sciences, tended to report higher levels of confidence in their academic and mathematical abilities. Finally, defectors reported fewer physical science courses taken in high school than did persisters. Hence, when compared to those students who defected, students who were persisters or recruits in the physical sciences tended to show higher levels of academic achievement, higher levels of academic self-confidence, and better preparation in the physical sciences(see tables in Appendix C).

The findings concerning the goals and values of students who defect from the study of the physical sciences help to explain why defectors often choose to move into business fields. Defectors from physical science study tend to place greater value on goals pertaining to money, status, and entrepreneurial achievement than do students who either remain interested, or develop an interest in the physical sciences. After exposure to study in the physical sciences, those students who value money and status may find that these goals are incongruent with the lifestyle they believe is available to them as a scientist. This may help to explain the large "outflow" from the physical sciences into business fields.

The findings regarding differences in the college experiences of persisters, defectors, and recruits also indicate important differences. Students who defect from study in the physical sciences tend to work more often in part-time off-campus jobs or to work full-time while they are in college. Both of these experiences tend to separate these students from the college environment and limit the amount of exposure they have to many of the positive aspects of college attendance. Study in the physical sciences is extremely time intensive and demanding for students. Being removed from the college environment for substantial periods of time makes college even more difficult for science students. This is particularly true for students who must work full-time while they are in college.

Students who defect from the physical sciences also tend to report lower levels of satisfaction with classes offered in the sciences and mathematics. They also report lower levels of satisfaction in their relationships with faculty. Finally, defectors from physical science are less likely to report involvement in other important activities with faculty (i.e., assisting in teaching a class, assisting with research, being a guest in a professor's home).

Factors Involved in the Persistence, Defection, and Recruitment of Physical Science Majors

Persisters versus Defectors in the Physical Sciences

Persisters and defectors in the physical sciences come to college with similar educational aspirations. To better understand what happens to students who lose interest in the physical sciences, a stepwise regression analysis was performed to see what personal characteristics, college characteristics, and college experiences served to predict either persistence or defection in the study of physical science (the findings are summarized in Table 5.4).

Table 5.4
Physical Science Majors–Persisters versus Defectors
(N=835)

Variable	Simple r	b	Beta
Background Characteristics			
Scientific Orientation	.21	.08	.21
SAT-Math	.19	.001	.23
Expect to change major field	-.17	-.09	-.15
Status Striver (personality type)	-.14	-.02	-.14
Religious preference: Catholic	.06	.09	.09
College Environments			
Grant from the college	.15	.07	.07
Institutional selectivity	.03	-.005	-.14
Nonsectarian college	.06	.09	.09
(R=.39)			
College Experiences			
Completed at least 4 years	.10	(.08)	(.03)
Had paper critiqued by instructor	-.19	-.10	-.15
Took honors or advanced courses	.21	.10	.10
Left school or transferred	-.16	-.13	-.10
Took multiple choice exam	-.18	-.06	-.10
Full-time job	-.10	-.15	-.09
Hours per week: student clubs/organizations	-.08	-.02	-.09
Assisted faculty in teaching	.18	.10	.09
(R=.49)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Five of the input (or student background) characteristics entered the regression equation as predictors of persistence or defection. The first two variables served as predictors of persistence and represent measures of students' interest and aptitude toward the study of science. Scientific orientation is a motivational measure based on students' interest in and commitment to the study of science. The higher a student's scientific orientation, the more likely she/he is to persist as a physical science major. Scores on the mathematics portion of the Scholastic Aptitude Test (SAT) also predict persistence in physical sciences. This speaks to the crucial role that mathematical aptitude plays in students' success in the study of physical sciences.

Two other input variables predict defection from the study of physical science. The first of these was the students' estimate of the likelihood that they would change their major field sometime during their college careers. This finding is not all that surprising. The second predictor of defection was a personality measure called "Status Striving." Status striving reflects a concern with issues of money, materialism, and status. As discussed earlier, persons scoring high on status striving perhaps came to see the lifestyle of the scientist as being incongruent with their personal goals. Hence, to better fulfill these personal goals, such students feel that they have to change to another field of study.

A surprisingly low number of college environmental characteristics entered the equation as predictors of persistence. As was found in the overall regression (persisters, defectors and recruits combined; see Chapter 4), students who receive grants directly from the institution to help defray the costs of college are more likely to persist than students who do not receive this type of financial aid. In addition, students who attend the more selective institutions are more likely to defect from study in the physical sciences than are students who attend institutions of lower selectivity.

The third and final environmental variable to enter the regression equation is a dichotomous variable representing nonsectarian four year colleges. Students who attend this type of institution are more likely than students from other institutional types (i.e., public or private universities or public colleges) to persist as physical science majors.

There are two variables among the college experiences that warrant discussion in this summary of results. The first is working full-time while attending college, which is related to defection from physical sciences; the second is assisting a professor in teaching a class, which is related to persistence in the physical sciences. These findings clearly suggest that the more time a student can devote to school and to working with professors, the more likely that student is to remain in the physical sciences.

Summary of Findings Regarding Persistence and Defection in the Physical Sciences

In reviewing the findings regarding the comparison of persisters versus defectors in the physical sciences, we are able to develop a clearer picture of what differentiates these two groups from each other. Most of these findings confirm what was found in the overall analysis of physical science majors (Chapter 4). Persisters tend to be more scientifically oriented in their interests and motivation. In addition, they tend to have a higher aptitude for scientific study, as measured by their scores on the mathematics portion of the SAT. On the other hand, students who are more concerned with issues of money, materialism, and status will more likely defect from the study of physical science. As already mentioned, they may have discovered that the lifestyle of the scientist was incongruent with their personal values. This would also help to explain the large influx of physical science defectors into the business fields.

It is disappointing that so few variables measuring the college environment entered the equation as either predictors of persistence or defection. If more variables had entered as predictors, we may have been able to learn more about the relative effects of different college environments in this process. However, the variables that enter do tell us something. Students who receive aid in the form of grants from the college tend to persist more than students who receive other types of financial aid. In addition, students who attend nonsectarian four year private colleges tend to persist more than students who attend other types of institutions.

The lone predictor of defection among the college environments is the selectivity level of institutions. Students from more selective institutions tend to defect more than do students from institutions of lower selectivity. This may have to do with the competitive nature of many of the highly selective institutions. The effects of these highly competitive environments may serve to discourage interest in the study of physical science. This may have serious consequences for the quality of talent pursuing science careers, since selective institutions by definition, enroll a disproportionate number of the highest ability students.

The negative effects of working off campus (especially full time work) on persistence in physical science has clear implications for financial aid: policies that require students to work off campus will probably deplete the pool of prospective science majors.

Recruitment into the Physical Sciences

Students who were recruited into the study of science may be the most interesting group of all. It is from within this group that we may be able to find a short-term solution to plug some of the leaks in the science pipeline. By studying students who did not begin with a major in the physical sciences, and comparing those who switched into the physical sciences with those who did not, we can begin to identify those factors which serve to encourage or discourage the development of interest in the study of physical sciences. This comparison was done through another regression analysis which compared physical science recruits to non-recruits. The summary of results of this regression is presented in Table 5.5.

Non-physical science freshmen who qualify as "Scholars" (Scholars are students who rate themselves highly on academic ability, intellectual self-confidence, and mathematical ability, and aspire to advanced degrees) and who had a strong orientation toward science are most likely to become physical science majors. Being scientifically oriented is also related to persistence, as is the next predictor of recruitment: scores on the mathematics section of the SAT. Students who took more high school courses in computer sciences were also more likely to be recruited into the physical sciences from other freshman majors.

As would be expected, non-physical science freshmen who expect that they will change their career choice during college are also likely to become recruits in the physical sciences. Consistent with the aforementioned finding on computer science courses, freshmen who report that they used a personal computer while in high school are also slightly more likely than other students

Table 5.5
Physical Science Majors–Recruits versus All Others (N=11,398)

Variable	Simple r	b	Beta
Background Characteristics			
Scholar (personality type)	.13	.01	.11
Scientific orientation	.12	.02	.08
Classified as more than one personality type	-.00	-.01	-.03
SAT-Math	.11	.00002	.10
SAT-Verbal	.04	-.00001	-.07
Years of computer science in high school	.06	.01	.03
Race: African American	.03	.02	.03
Leader (personality type)	-.03	-.004	-.05
Religious preference: Jewish	-.03	-.01	-.02
Status Striver (personality type)	-.03	(.00005)	(-.01)
Personal goal: write original works	-.04	-.01	-.04
Expect to change career choice	.02	.01	.03
Used a personal computer in high school	.07	.007	.03
Years of physical science in high school	.07	(.003)	(.02)
Years of biological science in high school	-.01	-.01	-.03
1985 career aspiration: business	-.06	-.02	-.04
1985 career aspiration: law	-.04	-.02	-.03
1985 career aspiration: secondary education	.02	(.02)	(.02)
College Environments			
Financial support from parents	-.03	(-.001)	(-.01)
Distance from home to college	.03	(.00004)	(.00)
Faculty perception: student orientation	.05	(.001)	(.01)
Peers: Outside work	-.06	(-.01)	(-.02)
Faculty: Research orientation	-.02	-.003	-.08
Peers: Intellectual self-esteem	.07	(.002)	(.02)
Faculty perception: Diversity emphasis	.02	(.002)	(.02)
Peers: Scientific orientation	.07	(-.002)	(-.00)
Peers: percent majoring in physical sciences	.14	.003	.07
Peers: percent majoring in math/statistics	.08	.002	.03
Protestant college	-.01	-.02	-.03
(R=.26)			
College Experiences			
Tutored another student	.12	.03	.09
Worked on professor's research	.08	.02	.05
Took an essay exam	-.06	-.01	-.03
Worked on group project for class	-.04	-.01	-.04
Assisted faculty in teaching	.09	.02	.04
Studied abroad	-.03	-.02	-.04
Took a multiple choice exam	-.06	-.01	-.04
Hours per week: student clubs/organizations	-.02	-.004	-.03
Hours per week: using a personal computer	.06	.004	.03
Had paper critiqued by instructor	-.05	-.01	-.03
Socialized with someone of another race	-.02	-.01	-.02
Participated in college internship program	-.04	-.01	-.02
(R=.30)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

to become recruits into the physical sciences during college. Finally, African-American students are more likely to be recruited into the study of physical sciences than are students from other racial backgrounds.

There are eight additional input variables which were significant as predictors of students remaining in some field other than the physical sciences. One of these is being classified as more than one personality type, which indicates how many different personality types (from none to seven) that the student resembles ("Scholar" and "Status Striver" are two of these types). Students who qualify for several types may have a variety of interests and abilities which make it difficult for them to commit to a highly specialized field such as physical science. Rather than limiting their studies in this way, they may prefer to leave their options open by opting for fields such as the social or behavioral sciences.

Those freshmen who were classified as "Leaders" (Leaders rate themselves highly on leadership ability, popularity, and social self-confidence) are also less likely than nonleaders to become recruits to the physical sciences. Again, Leaders are probably attracted to other academic disciplines which provide them with more opportunities to explore their interests. In addition, if Leaders subsequently chose to become involved in co-curricular activities and positions of leadership during college, it will be difficult for them to become successful physical science majors, given the heavy time commitment typically involved with these majors.

Another negative predictor of recruitment is the Verbal score on the SAT. Perhaps students with high verbal skills are more attracted to academic fields that afford them a better opportunity to use and develop these skills. This explanation would also apply to another negative predictor: the goal of writing original works. Surprisingly, taking many high school courses in the biological sciences also reduces the students' chances of becoming recruits into the physical sciences. If such students are attracted to scientific study, it is likely that they choose to do so in biology as opposed to the physical sciences. Finally, aspiring to a career in either law or business also reduces the freshman's odds of becoming a physical science recruit.

The two environmental variables that enter as predictors of recruitment provide evidence which supports the importance of student peer groups in the process of recruitment into the physical sciences: the percentages of students enrolled in the physical sciences and in mathematics and statistics courses are both positive predictors of recruitment into these major areas. The larger category of "physical sciences" used in these analyses comprises both of these major field areas.

One of the two variables that turn out to be negative predictors of recruitment is of particular concern: a strong faculty orientation toward research tends to discourage recruitment into the physical sciences. In other words, the more research oriented the faculty at an institution, the less likely it is that students will be recruited into majors in the physical sciences at that institution. Faculty with very strong research orientations tend to be concentrated in the very selective public and private universities that enroll large proportions of our ablest undergraduates. One possible interpretation of this effect is that faculty at these institutions are less involved with their undergraduate students because of their heavy involvement in research and the use of graduate students rather than undergraduate students as research assistants.

The fact that attending a Protestant college also decreases the student's chances of being recruited into study in the physical sciences may have to do with the historic focus on the arts and humanities at these institutions. Such a focus may serve to deter students at these institutions from switching into majors in the physical sciences.

With respect to college experiences, tutoring another student while in college increases the students chances of being a physical science recruit. While this finding suggests that the student's interest in and commitment to science study can be increased through collaborative work with other students, it may also be an artifact: students may be more likely to tutor other students because they switch into a physical science major.

The other two variables involved student interactions with faculty. Students who worked on faculty research and students who assisted faculty in teaching a class were both more likely to be physical science recruits than were students who did not engage in either of these activities. These findings confirm the overall regression results reported in Chapter 4.

Summary of Findings Regarding Recruitment in the Physical Sciences

Like students who persisted in the physical sciences, students who were recruited tended to have higher levels of academic preparation and scientific orientation. They scored higher on the mathematics section of the SAT and enrolled in more science-related classes while they were in high school.

But perhaps the most provocative finding concerns peer group effects: The positive effects of the percentage of peers majoring in physical science (reported in Chapter 4) appears to work primarily through recruitment rather than through retention. In other words, having many peers in the physical sciences serves less as a mechanism for retaining physical science majors (as suggested in Chapter 4) than as a magnet attracting dropouts from other majors: the greater the concentration of students in physical sciences, the more likely it is that students in other majors (engineering and biology, in particular) will switch into physical science.

A simple interpretation can be applied to the negative effect of faculty being strongly research-oriented: this faculty quality serves less to drive students out of the physical sciences than to discourage them from switching into the physical sciences from other fields. In all likelihood, the image presented by heavy faculty involvement in research (and the consequent lack of interest in undergraduates) is not appealing to students who might otherwise consider entering the physical sciences.

Students with strong verbal and language skills tended not to be recruited into the physical sciences. This also held true for students with strong career aspirations in business and in the law. Students with interests in these areas usually follow a much different educational path than do students in science fields, and, as a result may have little or no exposure to the study of science while in college.

The findings regarding the college experiences of students offer potentially important clues as to how to recruit more students into science. By involving more students in research with faculty and by providing more opportunities to participate in the education of other students, we might encourage more students to pursue physical science majors.

BIOLOGY MAJORS

Patterns of Stability and Change

As shown in Chapter 3, there was a trend toward loss of students majoring in biological sciences between the time that they first entered college in 1985 and when they were followed-up in 1989 (see Table 5.6). While the loss of biological science majors was evident for all students, the loss was greatest among women students. These figures indicate an "outflow" from majors in the undergraduate pipeline in the biological sciences.

Table 5.6
Percent Choosing Biological Science Majors: 1985-1989

		Percent		Percent Change
	N	1985	1989	1985-1989
All Students	26,306	11.9	6.2	-5.7
Men	10,592	12.1	6.7	-5.4
Women	15,396	11.9	6.0	-5.9

The descriptive data shown in Table 5.6 include all students for whom we had longitudinal data. (This "maximum" sample was also used in the descriptive analyses reported in Chapter 3.) Subsequent analyses of biological science majors reported below use the more restricted sample, with no institution contributing more than one percent of the cases. For this reason, the aggregate figures from these multivariate analyses may deviate slightly from the data shown in Table 5.6.

More than half of those students who entered college with an initial major choice in the biological sciences ended up defecting from study in biology four years after entering college. In the more limited sample, 1,909 entering students indicated an interest in the study of biology at the time that they first entered college. After four years, 1,097 of these students had defected to some other field, however, only 380 students were recruited into study in the biological sciences during the same time, yielding a net loss of 717 students over the four years.

In order to better understand the patterns of change among those students who persisted, defected, and were recruited into study in the biological sciences, it is important to identify which fields tend to attract students away from biological sciences study and which fields yield a potential supply of recruits into the biological sciences. Table 5.7 lists the top fields into which defectors reported that they had changed their majors. While 11 percent of those students who defected from study in the biological sciences shifted into the physical sciences, the majority of these defectors were lost from study in scientific fields.

Table 5.7
Top Five Major Field Choices for Defectors from Biological Sciences
(N=1909)

Major field	Percentage
Social Sciences	28.1
Business	12.8
Physical Sciences	11.0
History/Political Science	9.8
Education	9.1

By tracking the original fields of study of those students who were recruited into study in biological sciences, we may be able to identify areas where recruiting efforts might best be directed to compensate for the loss of defectors from undergraduate science education. Table 5.8 shows those fields which supplied the highest percentages of recruits into the biological sciences.

Table 5.8
Five Top Initial Major Field Choices for Students Recruited to Biological Sciences
(N=380)

Major field	Percentage
Undecided	28.1
Other technical fields	13.4
Engineering	11.8
Health Professions	11.2
Business	10.0

Descriptive Characteristics of Persisters, Defectors, and Recruits

White students tended to comprise the largest proportion of recruits into study in the biological sciences followed by Asian-American students. African-American students tended to be among the highest proportion of students who defected from study in biology (see Appendix C). These patterns are similar to those found for engineering majors (see below).

If we can assume that a majority of initially undecided students were interested in science but simply undecided as to which science field they would choose as a major, then the bulk of the recruits to biological science come from other science fields (undecided, technical, engineering, health professions, etc). Again, we see the "one-way street" for science "traffic" during the college years.

Students who defect from study in biology tend to have lower high school grades than do persisters. Compared to recruits, both persisters and defectors report higher levels of academic preparation in the biological sciences during high school: 66.6 and 64.0 percent, respectively, as compared to 56.5 percent of the recruits who report completing at least two years of study in biological science. At the time they enter college, both persisters and defectors have higher degree aspirations than do recruits. During the four years of college, persisters maintained their high degree aspirations, while recruits' degree aspirations rose and the degree aspirations of defectors decreased.

Recruits are much more likely than either persisters or defectors to report that they considered it likely that they would change both their career choice and their major choice at the time that they entered college. They were also less confident in their academic abilities. Recruits felt that they would be less likely to maintain at least a "B" average while in college than did persisters or defectors.

Regarding the enrollment patterns of these three groups, both recruits and defectors report higher rates of transfer from the colleges that they entered as freshmen. The most important reasons that both groups gave for their decision to transfer include: (1) they wanted to reconsider their goals and interests, (2) they had changed their career plans, and (3) they wanted a wider course selection.

Factors Involved in the Persistence, Defection, and Recruitment of Students into Biological Science Majors

So that we could identify the factors that differentiated among the three groups of biological science students, we ran two separate regression analyses which (a) compared persisters to defectors and (b) compared recruits to those who maintained non-science major choices throughout the four years.

Persistence versus Defection in the Biological Sciences

The results of the regression predicting persistence versus defection in the biological sciences are summarized in Table 5.9. Positive predictors of persistence include the mathematics portion of the SAT, class rank from high school, and aspirations to be a research scientist at the time of college entry. Negative predictors (i.e., predictors of defection) include expecting to change major, having hedonistic tendencies, experiencing frequent feelings of depression prior to attending college, and having poor self-ratings on emotional health.

There are several aspects of the college environment that predict persistence. The percent of peers majoring in biological sciences has the strongest positive effect. However, the percent majoring in the physical sciences and the percent majoring in the social sciences both have negative effects on persistence in biology. These findings once again underscore the importance of peer group effects on student persistence. Students who are in environments with higher percentages of other students who share similar academic interests are more likely to persist than are those students who are in college environments with relatively few students in the same field. Conversely, biology majors will be more likely to change to some other major if high percentages of their peers are majoring in either physical science or social science fields.

It is of particular interest that attending institutions which offer an MBRS (Minority Biomedical Research Scholarship) program tends to enhance persistence in an initial choice of a

Table 5.9
Biological Science Majors–Persisters versus Defectors (N=1508)

Variable	Simple r	b	Beta
Background Characteristics			
SAT-Math	.15	.001	.20
Expect to change major field choice	-.11	-.05	-.09
Hedonist (personality type)	-.11	-.02	-.08
High school class rank	.13	.06	.08
Reason for college: Become a more cultured person	-.08	(-.03)	(-.05)
Felt depressed in high school	-.09	-.10	-.11
Self-rating: emotional health	-.05	-.04	-.08
1985 career aspiration: research scientist	.07	.11	.07
College Environments			
Merit-based aid	.13	(.04)	(.05)
Minority Biomedical Research Support	.06	.21	.09
Faculty perception: Lack of student community	.05	(.02)	(.03)
Peers: percent majoring in physical science	-.07	-.02	-.12
Private university	-.03	-.10	-.09
Peers: percent majoring in biological science	.09	.01	.12
Peers: percent majoring in social science	-.04	-.003	-.08
(R=.35)			
College Experiences			
Completed at least 4 years	.08	.19	.07
Worked on professor's research	.20	.16	.16
Hours per week: using a personal computer	-.15	-.03	-.10
Took honors or advanced courses	.15	.10	.10
Had paper critiqued by instructor	-.13	-.07	-.10
Participated in college internship program	-.09	-.09	-.08
Took women's studies course	-.12	-.09	-.08
Received tutoring in a class	.01	.08	.07
Hours per week: studying/homework	.06	.02	.07
(R=.45)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

biological science major. (Special science programs at institutions including the MBRS are described and discussed in Chapter 11 of this report).

Working on a faculty member's research project, enrolling in an honor's program, or having received tutoring in a class are all positively related to persistence among biological science majors. The potential positive aspects of involvement reflected in the first two of these activities has been previously mentioned in Chapter 4.

Recruitment into the Biological Sciences

A summary of the results of the regression analysis of recruits is presented in Table 5.10.

Table 5.10
Biological Science Majors–Recruits versus All Others (N=10,741)

Variable	Simple r	b	Beta
Background Characteristics			
Scientific orientation	.08	.01	.07
Years of biological science in high school	.08	.01	.06
High school GPA	.06	.005	.04
Expect to change major field choice	.05	.006	.03
Reason for college: Preparation for graduate school	.06	.007	.03
Leader (personality type)	-.02	-.002	-.03
Father's career: Doctor	.04	.02	.03
Personal goal: write original works	-.01	-.006	-.03
Years of computer science in high school	-.03	-.004	-.02
Mother's career: Engineer	.03	.13	.03
Status Striver (personality type)	-.02	(-.00009)	(-.02)
1985 Career aspiration: scientist-practitioner	.10	.05	.08
1985 Career aspiration: health professional	.08	.06	.07
1985 Career aspiration: undecided	.04	.02	.04
1985 Career aspiration: farmer or forester	.02	(.10)	(.02)
College Environments			
Use of written evaluations of students' coursework	.05	.02	.03
Faculty: Diversity orientation	-.02	-.01	-.05
Faculty: Liberalism	.03	.005	.04
Highly structured general education program	.02	.002	.03
(R=.20)			
College Experiences			
Worked on professor's research	.08	.02	.06
Had paper critiqued by instructor	-.05	-.01	-.05
Hours per week: using a personal computer	-.05	-.004	-.05
Assisted faculty in teaching	.05	.01	.04
Worked on a group project for class	-.06	-.01	-.05
Took a multiple choice exam	.01	.01	.04
Part-time campus job	.04	.01	.03
Hours per week: exercising	.02	.003	.03
(R=.24)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

A number of student background characteristics enter as significant predictors of recruitment. Students who have a higher orientation toward science (interest in a career as a research scientist or college science teacher, valuing the goal of making a theoretical contribution to science) at the time they entered college are more likely to be recruited into study in biology. Recruits, compared to non-recruits, also have higher high school grades and have more often completed at least two years of study in the biological sciences. Nonrecruits, by contrast more often report that they will probably change their major when they enter college.

Parental careers also serve as significant predictors of recruitment into biological science majors. Students whose fathers are doctors or whose mothers are engineers are more likely than other students to be among the biology recruits. This points to the continuing influence of parents as role models.

Finally, the entering career aspirations of students also have a positive effect on recruitment. Students are more likely to become recruits if they enter college with an interest in pursuing careers either as science practitioners (doctors, veterinarians, dentists), or as allied health professionals, or if they are undecided as to their freshman career aspirations.

One particularly interesting aspect of the college environment that influences recruitment into study in biology is attending colleges which use written evaluations instead of grades to evaluate students' work. (This effect was discussed earlier in Chapter 4.) Apparently, written evaluations encourage study in biology through recruitment rather than through retention.

There were three college experiences positively associated with recruitment into the biological sciences: working on a professor's research project, assisting faculty in teaching a class, and working part-time on campus. Possible explanations for these findings (e.g., as artifacts) have been previously presented in Chapter 4. The fact that these "intermediate outcomes" are related to recruitment reinforces the possibility of an artifact since the student would first have to change into a science major before getting involved in his or her professor's research.

Summary of Findings

There are interesting trends evident in each analysis which serve to clarify movement to and from study in the biological sciences during college. Some of these findings demonstrate the importance of high school preparation in this process. Students who are high achievers in high school, who take more high school classes in biology, and who are oriented toward the study of science are most likely both to persist in and to be recruited into study in the biological sciences while in college.

The entering career aspirations of students also serve as significant predictors of both persistence and recruitment into study in the biological sciences. Aspiring to be a research scientist increases the likelihood of persistence in a biology major. At the same time, aspiring to be a science practitioner (doctor, dentist, veterinarian) or allied health professional enhances the student's chances of becoming a recruit into study in the biological sciences.

As with the physical science majors, the student peer environment is important to persistence among biological science majors. Having many peers in the biological sciences helps students persist in biological science majors, whereas having many peers in either the physical sciences or social sciences tends to encourage defection from study in the biological sciences. (These findings are discussed in greater depth in Chapter 4.) Of special interest here is that the mechanisms of peer group effects operate differently in the biological and physical sciences. Whereas having many peers majoring in biology enhances persistence in biology majors, having many peers majoring in the physical sciences tends to enhance recruitment into physical science. This difference may have to do with the fact that physical science fields attract many more defectors from engineering and other science fields than do biological science majors.

Engineering Majors

Patterns of Stability and Change in Engineering Majors

In 1985, 2,771 or 10.5% of students in our sample indicated engineering as a probable major. By 1989 the population indicating engineering as a major had dropped to 1,567 cases or 6.0% of the sample, a loss of 4.5% (see Table 5.11).

Table 5.11
Percent Choosing Majors in Engineering: 1985-1989

	N	Percent 1985	Percent 1989	Percent Change 1985-89
Total	26,306	10.5	6.0	-4.5
Men	10,592	19.5	11.3	-8.2
Women	15,396	4.2	2.2	-2.0

The descriptive data shown in Table 5.11 include all students for whom we had longitudinal data. (This "maximum" sample was also used in the descriptive analyses reported in Chapter 3.) Subsequent analyses of engineering majors reported below use the more restricted sample, with no institution contributing more than one percent of the cases. For this reason, the aggregate figures from these multivariate analyses may deviate slightly from the data shown in Table 5.11.

Engineering as a major shows a somewhat greater stability rate (43.9%) compared to physical sciences (35.2%) and biological science (36.3%). Nonetheless, more than one half of the students who initially planned to major in engineering changed their majors into different fields.

One fourth of students who defected from engineering majors chose business as their major. A little over one-fifth chose social sciences, history or political science while another fourth chose physical sciences or other technical majors. Examining the initial majors of students who were recruited into engineering, almost one-half (47%) came from the natural sciences and from other technical fields and another fourth came from business and from students who were undecided about their probable major (see Tables 5.12 and 5.13).

While this brief analysis describes in global terms the overall losses and changes with respect to majors in engineering, the analyses that follow were undertaken in order to identify factors that differentiate between the group of persisters, defectors and recruits.

Table 5.12
Five Top Initial Major Field Choices for Students Recruited into Engineering Major
(N=268)

Major field	Percentage
Other technical fields	21.5
Physical Sciences	19.8
Undecided	14.0
Business	6.4
Biological Sciences	5.8

Table 5.13
Five Top Major Field Choices for Defectors from Engineering Major
(N=758)

Major field	Percentage
Business	23.5
Social Sciences	13.9
Physical Sciences	13.3
Other technical fields	11.3
History/Political Science	7.1

Descriptive Characteristics of Persisters, Defectors, and Recruits

Examining the racial composition of the three groups we find that among recruits there are higher proportions of whites and Asian Americans, while among defectors there are higher proportions of black students (see table in Appendix C).

Defectors tend to achieve lower grades in both high school and college as compared to persisters and recruits. On the other hand, recruits tend to be somewhat higher achievers based on grades than are the persisters. Also, recruits tend to have higher degree aspirations than either defectors or persisters.

Looking at the academic progress as reflected in degree completion four years after matriculation, we find that 63% of persisters had received BA degrees compared to 50% of recruits and 60% of defectors. The lower rate of degree completion for recruits ($p<.01$) is understandable, considering the fact that making up for required courses in a major such as engineering is bound to take longer for students who started college in other majors.

Examining the transfer patterns or interruptions, we find that defectors indicate a significantly higher rate of such behaviors than either of the other two groups (21% of defectors compared to 9% of persisters and 17% of recruits). Reasons for such interruptions or transfer follow expected explanations—change in career plans and not doing well academically. Both reasons were endorsed by higher proportions of defectors than of recruits (42.9% and 27.3%, respectively).

Interestingly enough, what characterizes the recruits more so than the defectors is a sizeable career indecision as they begin college: 27% (versus 12% of defectors) indicate a high likelihood of changing their career plans and 28% (versus 13%) indicate expectations of changing their majors.

With respect to behaviors in college, defectors tend to be more involved than either persisters or recruits in political activities (discussing politics, participating in demonstrations), to take ethnic studies courses and to attend racial awareness workshops. (These latter two variables could well be the result of changing majors rather than a cause of such a change.)

In a self-assessment involving personal traits, fewer of the defectors than persisters rate themselves high in mathematical abilities (77% compared to 93%). Defectors also differ from persisters with respect to their life goals at the time of college entry, having a stronger "other" or humanistic orientation. That is, higher proportions of them are interested in helping others in difficulty, in influencing the political structure and social values, in involving themselves in community action programs and in promoting racial understanding.

With respect to expected careers at the time of college entry, recruits tend to indicate Business, Medicine, and Research Scientist as expected careers more often than do either the persisters or the defectors. Also, as might be expected, a much higher proportion of recruits are undecided about their expected careers.

There are also differences among the three groups when it comes to reasons they give for their career choice at the time of the follow-up. Defectors are more likely to be attracted to careers that may enable them to work with people and to have freedom of action in their work. On the other hand, persisters more often indicate "job opportunities" and "financial benefits" as reasons for their choice. Not surprisingly, recruits and persisters are similar in the reasons they give for their career choices.

Factors Involved in the Persistence, Defection and Recruitment of Engineering Majors

As with biological science majors and physical science majors, separate regression analyses were performed of (a) persisters and defectors and (b) recruits and all other choices of major field of study. The analysis for 'recruits' was run separately for men and women as well, since gender entered the regression equation in the analysis of recruits versus all other majors.

Persisters Versus Defectors in Engineering

Table 5.14 lists the variables that entered the equation with significant weights. Those in parentheses are variables that were not significant in the final solution. The variables are listed in sequence: input, environmental, intermediate outcomes.

Many of the input characteristics are the same as those found in the overall analysis (Chapter 4). Students who persist, compared to those who defect, have higher scores on SAT Math and had earned higher grades in high school. Having a father who is an engineer also predicts persistence in an engineering major, as does having an SEOG (Supplemented Educational Opportunity Grant) while in college. With respect to curricular matters, attending an institution with a "major dominated" general education curriculum enhances persistence. This is understandable, since being immersed in engineering courses with few other course requirements reinforces one's competencies and interest in engineering. While these five variables emerged as predictors of persistence, there are a number of other variables that describe students who are more likely to defect.

Table 5.14
Engineering Majors–Persisters versus Defectors (N=1094)

Variable	Simple r	b	Beta
Background Characteristics			
SAT-Math	.23	.00078	.15
Uncommitted (personality type)	-.16	-.03	-.14
High school grades	.20	.05	.12
Leader (personality type)	-.10	-.02	-.08
Father's career: Engineer	.11	.10	.08
Reason for college: Become a more cultured person	-.10	-.05	(-.07)
Reason for college: Parents' expectations	.03	.04	(.05)
1985 career aspiration: other	-.08	-.13	(.07)
College Environments			
Supplementary Educational Opportunity Grant	.08	.15	.08
Faculty: time spent teaching & advising	-.29	-.17	-.29
Major-dominated general education program	.02	.28	.14
Faculty: percent teaching interdisciplinary courses	-.02	.00	-.10
Faculty: percent with PhDs	.10	-.01	-.11
(R=.44)			
College Experiences			
Completed at least 4 years of college	.13	.02	(.01)
Took an essay exam	-.41	-.19	-.26
Took a multiple choice exam	-.32	-.15	-.21
Worked on a group project in class	.23	.15	.21
Took ethnic studies course	-.24	-.13	-.10
Part-time off-campus job	-.11	-.07	-.07
Had a paper critiqued by an instructor	-.25	-.06	-.07
Left school or transferred	-.21	-.09	-.07
(R=.65)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

It appears that uncommitted students (that is, students who at the time of matriculation indicated that they might change their career plans and majors, or that they might drop out or transfer) were more likely to defect from engineering. Also, students who scored high on Leadership (a personality measure reflecting self-ratings on leadership ability, popularity, and social self confidence) were more likely to defect. Defection is also precipitated by attending institutions where many faculty hold Ph.D.s, teach interdisciplinary courses, and spend a lot of time teaching and advising undergraduates. Institutions that are characterized by such qualities include selective institutions, private universities, and small selective liberal arts colleges. In all likelihood, such institutions have relatively weak engineering programs.

Looking at the intermediate set of variables, most can be explained as consequences rather than causes of persistence or defection: persisters more often work on group projects while in college, while defectors more often take ethnic studies courses. However, the fact that defectors are more likely to have part-time jobs off campus may be of policy significance: off-campus work tends to isolate the student from the steadying peer influences of like-minded (e.g., engineering) students.

Recruitment into an Engineering Major

Students who are recruited into an engineering major, compared to non-recruits, have higher SAT Math scores, more often use personal computers and participate in science contests, and have stronger Scientific Orientations. Scientific Orientation is a measure reflecting the students interest in a career as a college teacher or research scientist and in the life goal of "making a theoretical contribution to science."[1] Since some recruits also express an interest in careers in engineering as entering freshmen, they must have been "undecided" as to which particular field of engineering they would eventually choose as a major. Such a finding reinforces the argument that many freshmen who say they are undecided about a major but later become SME recruits are in fact already committed to science when they first enter college.

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[1] See Chapter 2 for details about the development of factor scores.

On the other hand, students are less likely to be recruited into engineering if they are women, have a hedonistic orientation (e.g., engage in party-type behaviors such as smoking, drinking, etc.), or have taken a lot of biological science classes while in high school.

Looking at the kinds of colleges these students attend and the kinds of experiences that influence their interests and their ultimate recruitment into engineering we observe the following: the student's chances of becoming a recruit are increased by attending a four year public college or an institution with a high percentage of peers majoring in either engineering or business. The percent of peers majoring in engineering is by far the most potent factor encouraging recruitment, even though this peer group measure does not affect persistence. An identical pattern was found with choosing a physical science major and the percent of peers majoring in physical science: recruitment, but not retention, is positively affected by peers.

Students' chances of becoming engineering recruits are reduced by attending large institutions, private universities, and institutions with high expenditures for student services. It may be that such institutions present the students with a great variety of competitive courses and majoring options. As far as intermediate outcomes are concerned, recruits indicate that they work in group projects while in college, spend a great deal of time studying and doing homework, work full-time and have received tutoring. Full-time work may reflect internship-type experiences in organizations or settings that involve experiences with engineering or applied science. Also, group projects appear to be a common experience among students majoring in engineering.

Tutoring may have been essential to students who decided to shift into engineering from other majors, since they probably had not taken the necessary course sequence, and may have needed assistance in overcoming deficiencies or lack of essential preparation.

Students who work many hours or work for pay or do volunteer work while in college, on the other hand, are less likely to become recruits into engineering. The negative correlation of hours spent working for pay is puzzling, given the positive correlation of full-time work (above). Could it be that "full-time" work was not paid work, but rather some kind of internship as suggested above? Clearly, this apparent contradiction needs further study.

Table 5.15
Engineering Majors–Recruits versus All Others
(N=11,139)

Variable	Simple r	b	Beta
Background Characteristics			
SAT-Math	.12	.00005	.05
Gender: female	-.11	-.01	-.04
Scientific Orientation	.08	.00	.03
Social Activist	-.04	-.00	(-.02)
Used personal computer in high school	.06	.00	.02
Hedonist (personality type)	-.03	-.00	-.03
Father's career: Engineer	.03	.00	(.01)
Participated in high school science contest	.06	.01	.03
Years of biological Science in high school	-.03	-.00	-.03
Reason for College: Get a better job	.02	.00	(.01)
Science preparation in high school	.07	.00066	(.01)
1985 Career aspiration: engineering	.36	.36	.31
1985 Career aspiration: other	.00	.01	(.02)
College Environments			
Grant from the college	-.02	-.00	(-.01)
Faculty: percent in science	.20	.00016	(.01)
Faculty perception: resources & reputation emphasis	.14	.01	.08
Faculty: Humanities orientation	-.12	-.00	(-.01)
Faculty perception: Lack of student community	.05	.00	(.01)
Faculty: colleagues are a source of stress	-.07	-.02	(-.02)
Faculty: percent teaching interdisciplinary courses	-.00	.00015	(.01)
Faculty: liberal political orientation	-.01	.00	(.01)
Peers: percent majoring in engineering	.26	.00	.17
Public four-year college	.05	.03	.09
Total enrollment	.09	-.01	-.07
Percent expenditures on student services	-.10	-.00	-.05
Peers: percent majoring in agriculture	-.01	-.00	-.03
Private university	.04	-.01	-.04
Peers: percent majoring in Business	-.05	.00030	.04
(R=.44)			
College Experiences			
Completed at least 4 years of college	-.04	-.01	-.02
Took an essay exam	-.13	-.02	-.09
Took a multiple choice exam	-.07	-.01	-.08
Worked on a group project in class	.05	.02	.08
Gave a class presentation	-.06	-.01	-.04
Hours per week: studying/homework	.06	.00	.03
Had a paper critiqued by an instructor	-.09	-.01	-.03
Participated in college internship program	.01	.01	.03
Full-time job	.03	.01	.03
Hours per week: working for pay	-.04	-.00	-.03
Received tutoring	.02	.01	.02
Hours per week: volunteer work	-.04	-.00	-.02
(R=.46)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Since women are less likely than men to be recruited into engineering, we proceeded with separate analyses for women and men. Those analyses were done in order to get a better sense of what special factors might potentially help in the recruitment of women into engineering (see Tables 5.16 and 5.17).

It appears that women with high SAT-M and early career interests in engineering were more likely to be recruited into engineering majors later on if they also attended public four year institutions with large numbers of students graduating in engineering and in business. Also, using personal computers while in college and receiving tutoring were experiences that played a role in enabling female students with early competencies in math and science and appropriate interests to consider majoring in engineering later on.

Summary of Findings

The analysis of persisters, defectors, and recruits into engineering majors suggest that both early student characteristics and college experiences play a role. Math ability and a scientific orientation early on characterizes both persisters and recruits. However, students who may start in engineering but who seem to be uncertain about their interest and commitment to such a major and who at the same time show social and leadership qualities are less likely to persist.

Students who indicate an interest in engineering and attend a college or university which has an engineering focus, and where large numbers of students are majoring in and graduating from engineering, are more likely to persist. In other words, peers with similar interests seem to reinforce one's early choices in engineering.

The three most potent environmental factors affecting the recruitment of women into engineering are also the most potent factors for men: the percent of peers majoring in engineering, the percent of faculty in science fields, and attending a public four-year institution.

Table 5.16
Engineering Majors–Recruits versus All Others--Men
(N=4,003)

Variable	Simple r	b	Beta
Background Characteristics			
SAT-Math	.13	.00013	.08
Scientific orientation	.09	.01	.04
Uncommitted (personality type)	-.04	-.01	-.04
Reason for college: Get a better job	.04	.01	(.00)
Used a personal computer in high school	.08	.01	.04
Father's career: Engineer	.06	.02	(.02)
SAT-Verbal	.05	-.00010	-.05
Years of physical science in high school	.08	-.00	(.02)
1985 Career aspirations: engineering	.38	.39	.33
1985 Career aspirations: other	.02	-.02	(.03)
College Environments			
Living on campus	-.03	-.02	-.04
Faculty: percent in science	.22	-.00020	(-.01)
Faculty perception: resource & reputation emphasis	.18	.01	.07
Faculty: Humanities Orientation	-.16	.00	(.01)
Peers: percent majoring in engineering	.30	.00	.19
Public four-year college	.07	.04	.06
(R=.46)			
College Experiences			
Completed at least 4 years of college	-.06	-.08	-.09
Completed at least 3 years of college	-.00	.07	.06
Took an essay exam	-.19	-.04	-.11
Took a multiple choice exam	-.09	.03	-.11
Worked on a group project in class	.08	.03	.11
Gave a presentation in class	-.09	-.02	-.06
Participated in college internship program	.02	.02	.05
Had a paper critiqued by an instructor	-.12	-.02	-.05
Hours per week: studying/homework	.09	.00	.04
Hours per week: working for pay	-.06	-.00	-.05
Full-time job	.03	.03	.05
(R=.51)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Table 5.17
Engineering Majors–Recruits versus All Others--Women
(N=7,136)

Variable	Simple r	b	Beta
Background Characteristics			
SAT-Math	.08	.00003	.04
Scientific orientation	.05	.00	(.03)
Race: Puerto Rican	.04	.02	(.01)
Social Activist (personality type)	-.03	-.00070	(-.02)
Intellectual self-esteem	.06	.00055	(.03)
1985 Career aspirations: engineering	.25	.24	.21
College Environments			
Faculty: percent in science	.15	.00027	(.03)
Faculty: Humanities Orientation	-.09	-.00	(-.04)
Faculty: colleagues are a source of stress	-.06	-.02	-.03
Faculty perception: resource & reputation emphasis	.10	.00	.08
Faculty: percent teaching interdisciplinary courses	.01	.00015	(.03)
Faculty: positive administrative environment	-.08	.0007	(.01)
Faculty: percent involving students in research	.05	-.00012	(-.01)
Peers: percent majoring in Engineering	.20	.00	.15
Public four-year college	.04	.03	.15
Peers: percent majoring in agriculture	-.02	-.00	-.05
Total enrollment	.05	-.00	-.11
Peers: percent majoring in math/statistics	-.01	-.00	-.04
Percent expenditures on student services	-.07	-.00	-.07
Peers: percent majoring in education	-.05	-.00060	-.06
Private university	.03	-.01	-.04
Peers: percent majoring in business	-.03	.00019	.04
(R=.34)			
College Experiences			
Worked on group project in class	.04	.01	.05
Took an essay exam	-.06	-.01	-.06
Hours per week: using a personal computer	.04	.00	.03
Took a multiple choice exam	-.03	-.00	-.04
Received tutoring	.02	.01	.03
(R=.37)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

RESEARCH SCIENTIST CAREER

This section presents the patterns of persistence, defection, and recruitment into careers in scientific research and reviews the factors that differentiate these three groups of students.

Patterns of Stability and Change

Table 5.18 shows men's and women's interests in the scientist career upon college entry, as well as four years later. Interestingly, there is a slight net increase in interest in scientific careers (+0.4) during the four years of college. Men exhibit initially greater interest in becoming scientists than do women (4.1%, as compared to 2.7% for women), and the net increase of men's science career aspirations is slightly greater than it is for women.

The descriptive data shown in Table 5.18 include all students for whom we had longitudinal data. (This "maximum" sample was also used in the descriptive analyses reported in Chapter 3.) Subsequent analyses of Research Scientist Career reported below use the more restricted sample, with no institution contributing more than one percent of the cases. For this reason, the aggregate figures from these multivariate analyses may deviate slightly from the data shown in Table 5.18.

Table 5.18
Percent choosing Research Scientist Career: 1985-1989

	N	Percent		Percent change
		1985	1989	1985-1989
Total	26,306	3.3	3.7	+0.4
Men	10,592	4.1	4.8	+0.7
Women	15,396	2.7	2.9	+0.2

Among the students who aspire to scientific careers upon college entry, 37.1% persist in these aspirations throughout the next four years. Table 5.19 describes the career choices cited by defectors from research scientist careers. The most popular career choice of defectors is business, followed by "other," elementary or secondary school teaching, engineering, and undecided. Interestingly, a full 72.3% of students choosing scientific careers four years after entering college have been recruited from other fields. Among recruits into scientific careers (Table 5.20), a large proportion were initially undecided about their freshman career aspirations (21.6%), while many others were recruited from career interests such as medicine, engineering, "other," and computer programming.

Table 5.19
Five top career choices for defectors from Research Scientist Career
(N=338)

Career Choice	Percentage
Business	14.4
Other	13.8
Education	13.2
Engineer	8.4
Undecided	7.2

Table 5.20
Five top initial career choices for recruits to Research Scientist Career
(N=519)

Career Choice	Percentage
Undecided	21.6
Physician	21.4
Engineer	16.2
Other	7.8
Computer Programmer	5.4

Descriptive Characteristics of Persisters, Defectors, and Recruits

Persisters are much more confident in their initial career decisions than are defectors or recruits; only 11.1% of persisters thought that they were very likely to change their career choice during college, as compared to 24.0% for recruits, and 20.9% for defectors.

Persisters also have much higher high school grades than either recruits or defectors. Upon entry to college, persisters rate themselves slightly higher than recruits and defectors in academic ability, artistic ability, mathematical ability, and writing ability, and rate themselves the lowest in social self-confidence. Four years later, the only significant changes are that defectors become much less confident in math, and that all three groups become more confident in their writing ability and social skills.

Although defectors from the research scientist career category report the lowest levels of satisfaction with science and math courses in college, they are nevertheless satisfied with these courses (80.4% are satisfied or very satisfied).

Science persisters and recruits are much more likely than defectors to plan to attend graduate school immediately after four years of college, while defectors are more likely to plan to remain in college or work full-time.

Factors Involved in the Persistence, Defection and Recruitment of Research Scientists

Persisters versus Defectors in Research Scientist Careers

Table 5.21 lists the variables associated with persistence of research scientist career aspirations, as well as the simple correlations, standardized and unstandardized regression coefficients for each variable with respect to the dependent variable. Among students who begin college with the intent of becoming scientists, women are significantly less likely than men to aspire to be scientists four years later. Hedonistic students (i.e., those who drink and smoke and who spend greater amounts of time "partying" and staying up all night), are less likely to maintain their interest in science as a career four years later. This result is consistent with Astin's (1993) finding that students with "hedonistic" tendencies are less likely to choose careers which are academically demanding.

Students placing a high priority on raising a family are less likely to persist towards careers as research scientists. Perhaps realizing the intense time commitment that science careers demand, as well as the time that would need to be spent in graduate programs, family-oriented students become less interested in pursuing science careers.

Having a mother who is a research scientist enhances persistence towards a career as a scientist. Clearly, having a mother to act as a career role model can influence students' persistence in and commitment to science.

SAT Verbal scores are also positively related to persistence towards careers in science. However, intending to major in engineering reduces students' chances of still planning to be scientists four years later. In all likelihood this represents the 8.4% of defectors who choose

Table 5.21
Research Scientist Career: Persisters versus Defectors
(N=435)

Variable	Simple r	b	Beta
Background Characteristics			
Gender: female	-.15	-.16	-.17
Hedonist (personality type)	-.14	-.05	-.16
Personal goal: raise a family	-.13	-.07	-.14
Mother's career: Research scientist	.14	.58	.13
SAT-Verbal	.14	.00023	.13
Intended major: engineering	-.16	-.5	-.17
(R=.36)			
College Experiences			
Worked on professor's research project	.32	.28	.29
Fraternity/sorority membership	-.17	-.21	-.18
Had a paper critiqued by an instructor	-.17	-.11	-.16
Part-time off-campus job	-.16	-.14	-.14
Assisted faculty in teaching	.18	.14	.14
(R=.56)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

engineering as a career four years later. As discussed earlier, this finding probably reflects the competition for students which exists between engineering and the sciences on many college campuses.

No college environments enter as significant predictors of persistence of research scientist career aspirations. College activities positively associated with persistence towards the scientist career are working on a professor's research project and assisting faculty in teaching a course. Involvement measures negatively associated with persistence include joining a fraternity or sorority, having a paper critiqued by an instructor, and holding a part-time off-campus job. While most of these measures may be artifacts of persistence in or defection from science career interests, there may be greater significance in the relationship between holding a part-time job off campus and defection from science. Given the time commitment required to succeed in the sciences, students spending more time working off-campus have less time to devote to the demands of college science programs.

Recruitment into Research Scientist Careers

A number of background characteristics with positive effects on recruitment into science careers are associated with scientific preparation and training (Table 5.22). Having a strong scientific orientation, having high SAT Verbal scores, taking many physical science courses in high school, coming to college to prepare for graduate school, and qualifying for the Scholar typology are all positive predictors of recruitment into careers in scientific research. However, this finding is likely explained by the fact that over 45% of all scientist recruits came from science-related fields, where students are already likely to have a strong science background.

Two personality measures are negatively associated with recruitment into scientific careers: Status Striver and Leader. Those students who desire financial success or high status jobs, as well as those who exhibit leadership qualities, are unlikely to be recruited into science during college. The Uncommitted personality measure enters as a positive predictor of persistence, although this effect can most likely be explained because expecting to change career choice is a component of this measure.

As has been shown with other career outcomes, parents' careers can have a positive influence on their children's career aspirations. Having a mother who is a research scientist and having a father who is either a research scientist or a college teacher all have positive effects on recruitment into scientific careers. In addition to having parents who are career role models, students with parents in research careers are likely to receive individualized mentoring and encouragement that may be necessary to recruit students into science.

Similar to the effects found with persistence of science career aspirations, placing a high priority on raising a family is negatively associated with recruitment of scientists. Again, the preparation and time commitment that is demanded of scientists may deter many students who place a high value on raising a family.

Table 5.22
Research Scientist Career: Recruits versus All others
(N=11,798)

Variable	Simple r	b	Beta
Background Characteristics			
Scientific orientation	.14	.03	.10
SAT-Verbal	.09	.00002	.03
Status Striver (personality type)	-.05	-.00071	-.04
Religious preference: none	.08	.04	.05
Mother's career: Research scientist	.05	.17	.04
Reason for college:			
Preparation for graduate school	.07	.01	.03
Uncommitted (personality type)	.05	.0008	.05
Scholar (personality type)	.10	.0007	.04
Father's career: College teacher	.06	.04	.03
Leader (personality type)	-.03	-..00	-.03
Political orientation: liberal	.05	.01	.03
Years of physical science in high school	.07	(.00)	(.02)
Race: Asian American	-.00	-.03	-.03
Personal goal: raise family	-.06	-.00	-.03
Personal goal: write original works	.01	(-.00)	(-.02)
Father's career: Research scientist	.04	(.04)	(.02)
Intended major: biological science	.12	.06	.09
Intended major: physical science	.10	.07	.08
College Environments			
Need-based aid	.04	.02	.04
Supplementary Educational Opportunity Grant	-.01	-.02	-.02
Written evaluations of students' coursework	.07	.03	.03
Faculty: Student Orientation	.03	.0010	.03
(R=.25)			
College Experiences			
Worked on professor's research project	.17	.06	.12
Took honors or advanced courses	.10	.01	.04
Worked on a group project in class	-.07	-.01	-.04
Participated in college internship program	-.05	-.02	-.04
Assisted faculty in teaching	.08	.02	.03
Did independent research project	.09	.01	.03
Hours per week: volunteer work	-.02	(-.00)	(-.02)
Took ethnic studies course	-.01	-.01	-.03
Took remedial/development courses	-.04	-.02	-.03
Hours per week: talking with faculty outside class	.05	.01	.03
Hours per week: using a personal computer	.01	-.00	-.03
Hours per week: hobbies	-.03	-.00	-.02
Hours per week: attending religious services	-.05	-.00	-.03
Fraternity/sorority membership	-.05	-.01	-.02
(R=.31)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

As would be expected, students majoring in biological or physical sciences are more likely to be recruited into science careers.

Students' chances of being recruited into a research career are increased by attending institutions which utilize written evaluations in grading and where the faculty are perceived as being student-oriented. Both of these measures suggest a faculty that is closely involved with student learning. Institutions which emphasize a student orientation also appear to be slightly more successful in recruiting students into scientific careers.

Working on a professor's research project and working on an independent research project are both positively associated with recruitment into science careers. While these findings may be artifacts (students who ultimately choose science careers are more likely to have received research opportunities in college), perhaps getting hands-on research experience, as well as guidance from a professor, may be helpful in recruiting students into scientific research. The problem, of course, is that one needs first to take science courses in order to respond positively to such items.

Enrolling in an honor's program, assisting faculty in teaching a course, and the hours per week spent talking with faculty outside class are also positively related to science career recruitment. However, even after controlling for students' ability and preparation, students who have taken remedial/developmental courses are less likely to be recruited into science. Perhaps such college remedial programs place less emphasis on recruitment into the sciences than on helping students "catch up" in their academic preparation.

The remaining involvement measures associated with science career recruitment are probably the result of having science interests, rather than the cause. After controlling for the effects of all input, environmental, and involvement measures, the following variables are negatively associated with recruitment: hours per week spent using a personal computer, working on hobbies, attending religious services or meetings, and doing volunteer work, joining a fraternity or sorority, enrolling in an ethnic studies course, working on a group project for class, and participating in an internship program.

Gender Differences in Persistence

Since gender entered the regression analysis predicting recruitment, we ran separate analyses for women and men. What we found was the variables that predict persistence in research scientist careers for men and for women are very different. The two background characteristics that enter the equation for men (hedonist and engineering major) were both negatively related to persistence (see Table 5.23). That being an engineering major is negatively related to persistence in research scientist careers is not hard to explain. Many people who enter as engineering majors also express a desire to become research scientists or science teachers in universities. Since the engineering program is so specialized and concentrated at most institutions, the longer these students stay in an engineering program, the more likely they may be to decide that they are going to pursue careers in engineering rather than become research scientists. It is also possible that the peer environment in engineering programs is not a welcome environment for students who want to go into teaching and/or research, since most of the students in these programs are likely to be more applied in their orientation.

For women the situation is a little different. Entering college because one wishes to become a more cultured person is a positive predictor for persistence in the research scientist career (Table 5.24). Yet, scoring high on the personality type "social activist" is negatively related to persistence in this career field for women. Apparently, women who are interested in becoming research scientists are not likely to be involved in social activism.

Table 5.23
Research scientist career: Persisters versus defectors--men (N=213)

Variable	Simple r	b	Beta
Background Characteristics			
Hedonist (personality type)	-.18	(-.04)	(-.15)
Intended major: engineering	-.22	-.47	-.21
College Experiences			
Worked on professor's research	.28	.24	.24
Had class paper critiqued by instructor	.24	-.15	-.21
Part-time off-campus job	-.20	-.19	-.19
Tutored another student	.16	.14	.18
(R=.51)			

Notes: Coefficients presented for background characteristics are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Table 5.24
Research scientist career: Persisters versus defectors--women (N=222)

Variable	Simple r	b	Beta
Background Characteristics			
Reason for college: Become more cultured	.20	.15	.20
Activist (personality type)	.30	-.04	-.19
College Experiences			
Worked on professor's research	.43	.28	.20
Fraternity/sorority membership	.48	-.25	-.22
(R=.48)			

Notes: Coefficients presented for background characteristics are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation.

No environmental variables entered into the equation for either women or men. However, some involvement variables did enter. Interestingly, having worked on a professor's research project enters positively for both women and men. This is a theme that has been recurring throughout these analyses. Obviously, the importance of students being actively involved in the educational process as well as being involved with faculty is not to be overlooked in the efforts to retain more science students. For women, having been a member of a sorority is a negative predictor of persistence in research scientist careers. For men, having tutored another student is positively related to persistence. Yet, having held a part-time job off campus is a negative predictor of persistence in research scientist careers. It is obvious that the level of academic and social integration in an institution is important for women and for men.

Summary of Findings

Men are initially more interested in scientific research careers than are women, and are more likely to persist in their science career plans. Students who defect from scientific research career aspirations gravitate towards business, education, and engineering. The majority of students who are recruited into scientific research are those who originally aspired to be physicians, engineers, and computer programmers, or who were initially undecided about their career aspirations.

Persisters exhibit less career ambivalence and greater academic ability and academic self-confidence than do defectors. Students who place a priority on raising a family are less likely to persist with their research scientist career aspirations. Once again the effect of a parent's career is a positive on persistence in science. Students with mothers who are research scientists are more likely to maintain their interest in this career field.

Interestingly, while coming to college to become "more cultured" was negatively related to persistence among aspirants for engineering careers, this measure is positively related to persistence in scientific careers for women. Perhaps these women do not envision careers in scientific research as interfering with cultural pursuits. However, women who express an interest in social activism are less likely to maintain their initial scientific aspirations.

Among college activities promoting persistence of the research scientist career, working on a professor's research project is positively related to persistence, while holding a part-time job decreases one's chance of persisting in this career category.

Because nearly half of the students who are recruited into research scientist careers come from other science fields, and another 21.6 percent are from the ranks of the undecided (many of whom were no doubt undecided merely about which science-related career they wanted to pursue), the findings for recruits represent more of a transfer between scientific fields. As with persisters, recruits have greater academic ability and scientific preparation than non-recruits. Those students with parents in scientific or research careers are also more likely to be recruited into scientific research. We also find that having a family orientation is once again negatively related to recruitment.

Contrary to what was found for recruitment into engineering, an institution's student-orientation is positively related to recruitment into scientific careers. Additionally, gaining research experience and interacting with faculty are positive correlates of recruitment into scientific research.

Overall, students who either persist towards scientific research careers or are recruited into these careers share many of the same qualities. Both persisters and recruits tend to have strong high school preparation in science and exhibit high academic ability. Persisters and recruits both are apparently influenced by the high expectations of their parents, or by the scientific careers that their parents may have. Finally, persistence and recruitment into scientific careers is related to greater involvement with college faculty and through gaining hands-on experience with research.

While these last findings may indeed be artifacts (the result of being a persister or a recruit), they also raise the interesting possibility that the student's interest in a science career can be enhanced through such experiences.

SCIENCE PRACTITIONER CAREER

Patterns of Stability and Change

In order to be categorized in a science practitioner career, a student must aspire to a career as a physician, dentist, veterinarian, pharmacist, optometrist, or clinical psychologist. In 1985 11.8% of the students in our sample reported that they aspired to careers as science practitioners. By 1989, that figure had dropped to only 5.8% – a total loss of more than half of the students aspiring to such careers. Of all the science-related career fields, the science practitioner field lost the highest percentage of students. Of those students who leave this career field, 55.6% end up in non-science fields. Of those who remain in the sciences, 1.2% move into engineering careers and 6.1% aspire to careers as scientific researchers or college teachers. A higher percentage of women than of men start out aspiring to careers as science practitioners (12.2% and 11.3% respectively). However, a higher percentage of women drop out of this career category by 1989: women experience a net loss of 6.4% whereas men lose 5.4% of the students in this career field (see Table 5.25).

Table 5.25
Percent Choosing Practitioner career: 1985-89

		Percent		Percent change
	N	1985	1989	1985-1989
Total	26,306	11.8	5.8	-6.0
Men	10,592	11.3	5.9	-5.4
Women	15,396	12.2	5.8	-6.4

The descriptive data shown in Table 5.25 include all students for whom we had longitudinal data. (This "maximum" sample was also used in the descriptive analyses reported in Chapter 3.) Subsequent analyses of science practitioner career reported below use the more restricted sample, with no institution contributing more than one percent of the cases. For this reason, the aggregate figures from these multivariate analyses may deviate slightly from the data shown in Table 5.25.

The majority of students who start out with career aspirations as scientist practitioners aspire to careers as physicians. In fact, persisters are more likely to have initial career aspirations as physicians than are defectors (74.3% and 57.5% respectively). A large percentage (20.9%) of those who defected from this career category started out aspiring to careers as clinical psychologists. It is possible that some students who start out planning to become clinical psychologists end up aspiring to careers in research, education or other types of counseling careers.

Tables 5.26 and 5.27 provide a more detailed view of where students are recruited from and to which fields they defect. Table 5.26 shows the initial aggregated career choices of recruits. Of those who are recruited into the science practitioner career category, a high percentage (31.9%) start out undecided about what their careers will be. Of the recruits, 16.1% aspired to "other fields" such as computer programing, social work, and foreign service (diplomatic careers) as freshmen. Others (6.9%) come from science-oriented health occupations, such as lab technicians and dieticians. Some recruits also initially aspire to careers in engineering (6.9%), the arts (4.5%), and business (8.7%).

Table 5.26
Top six initial career field choices for recruits to science practitioner career
(N=367)

1985 Career choice	Percentage
Artist	4.5
Engineer	6.9
Health professional	6.9
Business	8.7
Other choice	16.1
Undecided	31.9

Table 5.27 looks at what career fields students defected to in 1989. Of those students who defect from the science practitioner category, a large percentage go into business (21.1%) or into law (8.9%). The next largest proportion of the defectors change their career choice to elementary or secondary education (12.5%). Many of these may not really be entirely "lost" from science, especially if they plan to teach in a science related field. Still others choose to become research

Table 5.27
Top five final career choices for defectors from science practitioner career (N=1,168)

1989 Career choice	Percentage
Lawyer	8.9
Research scientist	9.9
Education (secondary and primary)	12.5
Business	21.1
Other choice	21.1

scientists (9.9%). A high percentage of defectors choose careers classified as "other," such as computer programming, careers in the military, and in social work.

Descriptive Characteristics of Persisters, Defectors, and Recruits

Students who persist in the science practitioner career choice tend to be better prepared academically upon entrance into college than either defectors or recruits. Persisters are more likely to have taken two or more high school courses in physical science (79.8%) and biological science (62.1%) than are defectors (70.7% and 57.8% respectively) or recruits (65.7% and 48.3% respectively). Persisters are also more likely to have attained an "A" average in high school than are defectors or recruits.

Persisters and defectors tend to have higher educational aspirations upon college entrance than do recruits. In 1985 a high percentage of persisters and defectors aspired to doctoral degrees (92.7% and 80.5% respectively) compared to recruits (53.9%). However, by 1989 part of the pattern is reversed as recruits greatly surpass defectors in their aspirations for doctoral degrees (82.6% for recruits and 44.1% for defectors); the initially high aspirations among persisters remains stable at 92.1%.

Persisters tend to have a more positive self-concept relative to defectors and recruits. They tend to rate themselves higher on academic ability, artistic ability, drive to achieve, emotional health, leadership ability, mathematical ability, intellectual self-confidence, and writing ability. Persisters are more likely to say that they expect to be satisfied with their college experience. They are also more likely to expect to graduate with honors and to make at least a "B" average in college.

In the follow-up, persisters are also more likely than defectors to report being satisfied with their college experiences.

Factors Involved in the Persistence, Defection and Recruitment of Science Practitioners

Persisters versus Defectors in Science Practitioner Careers

Most of the student background characteristics which are related to persistence in the science practitioner career category have to do with students' high school preparation in science and their commitment to scholarly pursuits (Table 5.28). Thus, the typology factor "Scholar," SAT math scores, and aspirations for graduate school were all relatively strong predictors of persistence. Having a father who is a doctor also predicts persistence in career aspirations to be a science practitioner. As mentioned in Chapter 4, this relationship highlights the influence of parents as role models in the career aspirations of their children.

Table 5.28
Practitioner career: Persisters versus defectors (N=1,479)

Variable	Simple r	b	Beta
Background Characteristics			
Scholar (personality type)	.22	(.01)	(.08)
Expect to change career choice	-.20	-.10	-.17
SAT-Math	.18	(.0004)	(.09)
Race: White	-.11	-.09	-.07
Reason for college: preparation for graduate school	.17	.11	.08
Hedonist (personality type)	-.12	(-.02)	(-.08)
Father's career: Doctor	.08	.11	.07
College Environments			
Merit-based aid	.13	(.08)	(.08)
Peers: percent who are Jewish	.11	.004	.10
Pears: Social activism	.09	.07	.09
Faculty: colleagues are source of stress	-.08	-.18	(-.07)
(R=.37)			
College Experiences			
College grades	.21	.06	.12
Hours per week: using a personal computer	-.07	-.03	-.10
Worked on professor's research	.18	.10	.10
Took a multiple choice exam	.02	.06	.09
Hours per week: studying/homework	.11	.03	.10
Worked on a group project for class	-.11	-.06	-.09
Participated in intramural sports	.08	.05	.07
Hours per week: volunteer work	.10	.02	.08
Left school or transferred	-.10	-.09	-.06
Had paper critiqued by instructor	-.08	-.05	-.06
(R=.47)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Students are most likely to defect if they indicate at the time of college entry that they expect to change their career aspirations. Such students may be unsure of their decision to become science practitioners and are therefore willing to explore other options, perhaps in search of a better career "fit." As found in the overall analysis (Chapter 4), being white is a negative predictor of persistence in the science practitioner field. In other words, nonwhite racial groups persist at higher rates than do white students. Students who score high on the Hedonism personality measure (that is, students who enjoy cigarettes, liquor, partying and so forth) were also less likely to persist in this career. This is not surprising, considering that the pursuit of careers such as physician requires a lengthy and serious commitment.

Two of the environmental variables having positive effects on persistence are measures of the peer environment: the percent of Jewish students at the institution and the average level of social activism among the students at the institution. As mentioned in Chapter 4, the percent of Jewish students in an institution may be a proxy for the percent of premed students. Persistence in a science practitioner career is also enhanced by having a merit-based scholarship. This result once again underscores financial aid as a means of encouraging talented science students to pursue scientific career fields.

The amount of collegial stress reported by the faculty is a negative predictor of persistence. This variable may reflect the amount of competition faculty perceive among colleagues at their institution. Just how and why this variable should affect persistence, however, is unclear.

Many of the college experiences which predict persistence in the science practitioner career are related to the level of academic and social integration of students. Positive predictors include college grades and working on a professor's research project. These two variables highlight the importance of being academically involved with the environment at the institution. The number of hours students participate in volunteer work is also positively related to persistence. Given that most of the science practitioner careers fall into the broad category of "human service" careers, it is interesting to find that participation in volunteer service work may strengthen the student's interest in becoming a science practitioner.

Variables that are negatively related to persistence in practitioner careers--the number of hours students spend per week using a personal computer and having papers critiqued by instructors--may be artifacts. Simply put, students who are pursuing nonscience careers would be more likely than premed students to spend a lot of time typing papers and having them critiqued by their instructors. A similar interpretation can be made for having worked on a group project for a class (also a negative predictor of persistence). In other words, these "intermediate outcomes" may be the result, rather than the cause, of a student's decision not to pursue a science practitioner career.

Recruits into Science Practitioner Careers

Students who did not start out with aspirations to be science practitioners in 1985 but did so in 1989 were categorized as recruits. The variables that distinguish these students from students who remained in nonpractitioner careers appear to be very similar to the variables that distinguish persisters from defectors: scientific orientation, interest in graduate school, having a father who is a doctor and being nonwhite (Table 5.29).

Interestingly, being female is also a positive predictor of being recruited into the science practitioner career. Most of the findings up until this point suggest that women are less likely to be recruited into science. Since gender has no effect on persistence (Table 5.28) and a positive effect on recruitment into practitioner careers, it may well be the "human service" appeal of such careers that creates this unique pattern of gender effects. One interesting (and admittedly speculative) possibility here is that the appeal of other types of science careers for women might be strengthened if the "service" aspects of such careers could be given more emphasis.

The fact that picking a freshman major in biological science carries the strongest weight of all predictors suggests that many of the uncommitted students were already interested in science-related careers, but simply unsure at the time they started college as to which science career they would pick.

Table 5.29
Practitioner career: Recruits versus All others (N=10,770)

Variable	Simple r	b	Beta
Background Characteristics			
Scientific orientation	.07	.006	.03
Father's career: Doctor	.07	.05	.06
Reason for college: prepare for graduate school	.07	.01	.05
Uncommitted (personality type)	.05	.003	.04
Gender: female	.03	.01	.03
Race: White	-.04	-.02	-.03
Years of biological science in h.s.	.04	(.003)	(.02)
Status Striver (personality type)	-.01	(-.0005)	(-.01)
Intended major: biological science	.14	.09	.11
Intended major: business	-.06	-.02	-.04
Intended major: education	-.04	-.02	-.02
College Environments			
Living at home	.02	.01	.03
Faculty: positive toward general education program	.03	.02	.03
(R=.19)			
College Experiences			
Completed at least 4 years	-.04	-.04	-.05
Completed at least 2 years	.00	.05	.03
Hours per week: volunteer work	.07	.008	.06
Worked on a professor's research	.07	.02	.05
Took a multiple choice exam	.02	.02	.07
Gave a presentation in class	-.04	-.01	-.04
Took honors or advanced courses	.05	.01	.03
Worked on group project for a class	-.05	(.006)	(-.02)
(R=.22)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

There are only two environmental variables that predict recruitment into the practitioner career. That living at home during the freshman year is positively related to recruitment is interesting, given that students who are living at home would obviously have less frequent contact with the overall student population than would students who live on campus. That reduced contact with other students may not explain this effect is suggested by the college experience variables that entered the regression (see below). The other positive environmental effect is associated with a positive faculty attitude toward general education at the institution: if faculty are positive about the general education curriculum, students are more likely to be recruited into the science practitioner career. The meaning and significance of this effect is not clear.

Our discussion of college experiences will focus only on those experiences that are not obvious artifacts. As already suggested, the fact that the number of hours that students spend participating in volunteer work is a positive factor in recruitment suggests that volunteer work may reinforce students' interests in pursuing a career which will enable them to become a human service provider. Similarly, working on a professor's research project may serve to strengthen the student's interest in a practitioner career, especially if the research is connected to the health field.

Gender Differences in Recruitment

In order to understand further why women were more likely to be recruited into the science practitioner career, we ran regressions separately for men and for women. While there were some variables which were common to the two equations (having a father who is a doctor, wanting to prepare for graduate school, scientific orientation, and majoring in biological science) there were some variables that differentiated women from men. For example, being an African American was a positive factor in recruitment into the science practitioner career for women, but not for men. Men, on the other hand, are more likely to become recruits if they are noncitizens (see Tables 5.30 and 5.31).

Among college environments, living at home came in as a positive predictor of recruitment among women. For men, the percentage of students majoring in agriculture came in as a positive predictor. The significance of this lone (and weak) predictor is not clear.

There are several positive involvement variables that are common to both men and women: working on a professor's research project and taking multiple choice exams. Otherwise, most of the differences may well be artifactual.

Summary of Findings

From the descriptive analysis we find that persisters in science practitioner careers come to college with better preparation in the biological and physical sciences, better high school grades, and a more positive self-concept than either defectors or recruits. Persisters are also more

Table 5.30
Practitioner career: Recruits versus All others--men (N=4,151)

Variable	Simple r	b	Beta
Background Characteristics			
Father's career: Doctor	.08	.04	.05
U.S. Citizen	-.07	-.06	-.06
Scientific orientation	.07	(.006)	(.03)
Reason for college: Prepare for graduate school	.07	.008	.04
Status Striver (personality type)	-.03	-.001	-.03
Years biological science in h.s.	.05	(.004)	(.02)
Mother's career: Doctor	.05	.09	.04
Intended major: biological science	.17	.11	.16
Intended major: undecided	.05	.03	.05
College Environments			
Peers: percent majoring in agriculture	-.04	-.00	-.04
(R=.22)			
College Experiences			
Hours per week: volunteer work	.08	-.003	-.05
Worked on professor's research	.05	.02	.06
Took a multiple choice exam	.02	.01	.06
Worked on a group project for class	-.05	-.009	-.04
Discussed racial/ethnic issues	-.02	-.01	-.04
Took remedial/development courses	.04	.03	.04
(R=.25)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

committed to scholarly pursuits than are defectors. Defectors, on the other hand, are initially less committed to being science practitioners at college entry. That minority students persist more than white students is somewhat of a surprise, given that minorities do not show higher persistence in other science careers. Perhaps the lure of careers in fields like medicine and dentistry is sufficiently strong to enable minority students to persist in spite of difficulties of a premedical curriculum and the highly competitive nature of professional school admissions.

Many students who are recruited into the science practitioner careers enter college with an interest in science, but they have not yet decided on a science career. These students may well have the ability, preparation, and interest to succeed in science, but without a positive early experience with science courses and teachers, they may well end up pursuing nonscience careers.

Table 5.31
Practitioner career: Recruits versus All others--women (N=6,521)

Variable	Simple r	b	Beta
Background characteristics			
Scientific orientation	.09	.008	.04
Father's career: Doctor	.07	.06	.06
Uncommitted (personality type)	.06	.004	.05
Reason for college: Prepare for graduate school	.07	.009	.04
Race: African American	.04	.03	.04
SAT-Verbal	.04	.00007	.04
Intended major: biological science	.12	.08	.10
Intended major: social science	.04	.02	.04
College Environments			
Living at home	.02	.02	.03
(R=.18)			
College experiences			
Completed at least 4 years	-.06	-.05	-.05
Hours per week: volunteering	.05	-.03	-.10
Took a multiple choice exam	.02	.02	.07
Gave a presentation in class	-.06	-.02	-.06
Worked on professor's research	.07	.02	.05
Enrolled in honors program	.05	.01	.03
(R=.22)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation.

What is important in the recruitment of men as compared to women appears to be very different. Women who are most likely to be recruited into science practitioner careers are initially uncommitted but more socially oriented than other students. They also score well on the SAT verbal test and show an early interest in social science fields rather than the hard sciences. It appears that one of the major attractions of practitioner careers for women is the opportunity to provide personal services to others. Such an appeal should probably be a major part of any strategy intended to attract more women into scientific careers.

ENGINEERING CAREER

This section presents the patterns of persistence, defection, and recruitment into engineering careers and the factors that differentiate these three groups of students.

Patterns of Stability and Change

Table 5.32 compares men's and women's interest in engineering as a career upon entering college, as well as four years later. Although 10% of all college students aspired to become engineers at the point of college entry, only 4.7% aspire towards engineering careers four years later. However, when broken down by gender, we see that it is primarily men who come to college interested in engineering (18.6%, as opposed to 4.1% of women). The greater percentage loss of men from engineering merely reflects their greater interest in engineering at the start of college. Four years after college entry, 8.8% of men plan to be engineers, compared to only 1.9% of women.

Table 5.32
Percent choosing Engineering Career: 1985-1989

		Percent		Percent change
	N	1985	1989	1985-1989
Total	26,306	10.0	4.7	-5.3
Men	10,592	18.6	8.8	-9.8
Women	15,396	4.1	1.9	-2.2

Among students who selected engineering as a career choice upon college entry, 48.1% persisted in these plans. Listed in Table 5.33 are the most popular career choices of engineering defectors four years after college entry. Business is the most popular career choice among defectors, followed by military careers, computer programming, "other," and research scientist. Table 5.34 describes the most commonly cited initial career choices of engineering recruits, who account for 25.6% of those selecting engineering careers in 1989. In addition to the large number of students who are initially "undecided" about their exact career choice, engineering recruits are also drawn primarily from students initially interested in careers in business, computer programming, scientific research, and medicine. If we can assume that many of the initially

Table 5.33
Five top career choices for defectors from Engineering Careers
(N=800)

Career Choice	Percentage
Business	30.8
Military	13.0
Computer Programming	10.0
Other	8.7
Research Scientist	7.4

Table 5.34
Five top initial career choices for recruits into Engineering Careers
(N=255)

Career Choice	Percentage
Undecided	21.8
Business	14.6
Computer Programming	12.6
Research Scientist	12.6
Physician	9.2

undecided students fully intended to pursue a science career (but were uncertain as to which particular science career they preferred), and if we can assume that many (if not most) of those initially pursuing business careers were planning to study engineering, then the "one-way traffic" in engineering is even more than the data initially suggests. Clearly, the flow of traffic to and from engineering careers revolves around business, or around other scientific or technical fields. Interestingly, while engineering itself has been traditionally male-dominated, the various career choices cited by engineering defectors and recruits are in fields which have also been traditionally dominated by men. This result is perhaps to be expected, given that men account for more than 80 percent of those pursuing engineering careers both in 1985 and in 1989.

Descriptive Characteristics of Persisters, Defectors, and Recruits

Examining the profile of persisters, recruits, defectors with respect to aspirations for engineering careers, some noteworthy differences are evident among the three groups (see Appendix C). Defectors have lower high school grades than both persisters and recruits. Upon college entry, persisters rate themselves highest among the three groups in academic ability and mathematical ability, but rate themselves lowest on social self-confidence and writing ability.

Persisters are the least likely to expect to change their career choice during college (5.5%). Defectors display a slightly greater expectation to change their career choice (12.5%), while recruits into engineering are much more likely to expect to switch career plans during college (27.9%). Clearly, the students in these groups have some sense of the stability of their pre-college career aspirations even before they start college.

Those students who ultimately choose careers in engineering (persisters and recruits) are much more likely than defectors to base their career decisions both on perceived job opportunities that are available and on pay. In addition, persisters and recruits are both more likely than are defectors to say they base their career choices on their parents' expectations.

Persisters, defectors, and recruits each enter college with similar levels of commitment to making a "theoretical contribution to science." However, after four years of college, engineering persisters become slightly less interested in making theoretical scientific contributions (32.3% to 27.0%), defectors become much less concerned with making such contributions (32.1% to 15.1%), while recruits increase slightly their level of commitment to scientific theory (32.9% to 35.8%). Here is a case where a particular personal value appears to change in accord with changes in the student's career interests.

Factors Involved in the Persistence, Defection, and Recruitment of Engineers

Persisters versus Defectors in Engineering Careers

Table 5.35 shows that the background characteristic most strongly predicting persistence of engineering career choice is high school GPA. The only other background characteristic having a positive effect on persistence is attending college because of parents' expectations.

A number of background characteristics (those with negative signs), are related to defecting from engineering careers. Not surprisingly, the strongest factor for defection is expecting to change one's career choice. Clearly, students vary in their degree of commitment to an engineering career, and this ambivalence affects their chance of maintaining their career interests over the four years. This finding once again emphasizes the importance of an early commitment to science. Also, of those students who initially aspire to be engineers, those who come to college to get

Table 5.35
Engineering Career: Persisters versus Defectors (N=1,009)

Variable	Simple r	b	Beta
Background Characteristics			
High school grades	.12	.05	.14
Expect to change career choice	-.13	-.09	-.13
Reason for college:			
Preparation for graduate school	-.09	(-.07)	(-.09)
Reason for college: Parents' expectations	.06	(.05)	(.07)
Reason for college:			
Become a more cultured person	-.10	(-.06)	(-.07)
Intended major: physical science	-.13	-.21	-.08
College Environments			
Distance from home to college	-.12	-.04	-.10
Financial support from parents	.05	(.01)	(.04)
Pell Grant	.06	.14	.09
Financial support from part time job	-.05	-.11	-.10
Peers: Outside Work	.15	.21	.18
Faculty: percent teaching general education courses	-.13	-.00434	-.13
(R=.3680)			
College Experiences			
Took an essay exam	-.36	-.6	-.21
Took a multiple choice exam	-.28	-.12	-.17
Worked on a group project in class	.17	.10	.14
Had a paper critiqued by an instructor	-.28	-.10	-.14
Hours per week: studying/homework	.12	.03	.09
Took women's studies course	-.13	-.16	-.18
Left school or transferred	-.16	-.11	-.08
(R=.5631)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

training for graduate school are less likely to persist in this choice during the next four years. A third factor related to defection is coming to college to become a more cultured person. Finally, students who plan to major in the physical sciences are also less likely to maintain their engineering aspirations over time. This last finding may be related to the apparent competition for students between certain engineering and physical science departments, as already described in Chapter 4.

As reported in several earlier regressions, receiving financial aid from parents or from a grant increases students' chances of maintaining career interests in engineering. The fact that those students who work at part time jobs are less likely to persist may reflect the large investment of time and energy that is necessary to survive in the typical engineering curriculum.

The environmental variable having the strongest positive association with engineering persistence is the percentage of peers who work at outside jobs. This measure is characteristic of commuter institutions that are large and nonselective and that enroll many students from lower socioeconomic backgrounds. Among other things, such institutions do not have large social science, political science, and history departments that might attract students away from engineering. Also, because students attending these schools usually live at home, their main interaction with each other will be within their courses. Thus, the peer environment of engineering students at many commuter schools may consist primarily of other engineering students, a factor which may help to retain many of them within engineering.

Students who attend colleges away from home are less likely to maintain an initial interest in engineering. Living away from home provides students with new experiences and opportunities, many of which may attract some engineering students away from their initial career aspirations. Also negatively associated with engineering career persistence is the percent of faculty at an institution teaching general education courses. This finding probably reflects the effect of being at schools with large general education programs. The greater number of general education courses that students are required to take, the less likely they are to have maintained their initial career interest in engineering, since engineering as a major tends to require a large number of engineering or engineering-related courses.

College activities ("intermediate outcomes") positively associated with persistence of engineering career aspirations are working on a group project for a class and the hours per week spent studying or doing homework. Activities negatively associated with engineering persistence include taking an essay exam, taking a multiple choice exam, having a paper critiqued by an instructor, enrolling in a women's studies course, and leaving or transferring from school. However, as mentioned earlier and in Chapter 4, these findings may well reflect the result of persisting towards a career in engineering, rather than the cause.

Recruitment into Engineering Careers

Many of the background characteristics positively associated with recruitment into engineering are related to academic ability and preparation (Table 5.36). Students recruited into engineering fields are more likely than non-recruits to have greater scientific orientation, higher SAT Math scores, are more likely to have participated in a high school science contest, and are more likely to have used a personal computer in high school. These results underscore the importance of ability and early preparation in the production of engineers. Those who are more able and prepared are more likely to be attracted into engineering than other students. Yet, the fact that over 23% of recruits into engineering switched from other science fields may account for at least some of these findings.

Women students who desire to influence the social or political structure, or those with "hedonistic" tendencies are least likely to be recruited into engineering. Perhaps the subject matter and the intense time demands of engineering do not seem attractive to the activist/hedonist, who may not want to commit great amounts of time to studying this relatively specialized field.

While having a father who is an engineer is not related to persistence in engineering, it does increase a student's likelihood of being recruited into engineering. As pointed out earlier in this chapter and in Chapter 4, this emphasizes the importance of having a parent who can serve as a mentor or role model, thus allowing students to gain a first-hand understanding of science-related careers. It may also reflect in part the role of parents' expectations. As was found with engineering persistence, students who go to college because their parents expect them to go are more likely to be recruited into engineering, as are students who come to college in order to "learn more about things."

As was found with persistence, students who attend college in order to become more cultured are less likely to be recruited into engineering fields. This finding reflects the importance of values in the choice of an engineering career: students who are more culturally/artistically oriented tend to avoid the field, while the more academically inquisitive students are attracted to it. It is important to realize that these value effects are over and above the effects of ability and family background.

Table 5.36
Engineering Career: Recruits versus All others (N=11,224)

Variable	Simple r	b	Beta
Background Characteristics			
Scientific orientation	.09	.01	.04
SAT-Math	.09	(.00029)	(.02
Gender: female	-.09	-.01	-.03
Used a personal computer in high school	.07	(.00356)	(.02)
Activist (personality type)	-.04	(-.00087)	(-.02)
Participated in high school science contest	.07	.01	.03
Father's career: Engineer	.04	.01	.02
Reason for college: Parents' expectations	.02	.00477	.03
Hedonist (personality type)	-.03	-.00173	-.03
Reason for college: Become a more cultured person	-.04	(-.00439)	(-.02)
Reason for college: Learn more about things that interest me	.02	(.01)	(.02)
Race: African American	.01	(.00635)	(.01)
Intended major: engineering	.26	.22	.26
Intended major: vocational/technical	.07	.07	.07
Intended major: physical science	.07	.02	.05
Intended major: biological science	-.03	-.01	-.03
College Environments			
Living in private room or apartment	.03	(.02)	(.02)
Faculty perception: student orientation	-.08	(-.00130)	(-.02)
Peers: Outside Work	-.00	.03	.08
Faculty: percent in science	.14	(.00034)	(.02)
Faculty perception: resource and reputation emphasis	.09	.01	.08
Peers: intellectual self-esteem	.07	-.01	-.08
Peers: socio-economic status	.02	.00357	.09
Peers: percent who are Jewish	-.01	-.00054	-.04
Faculty perception: campus racial conflict	-.01	(-.00071)	(-.00)
Faculty: percent teaching interdisciplinary courses	-.00	(.00007)	(.01)
Peers: Percent majoring in engineering	.18	.00125	.10
Undergraduate enrollment	.03	-.000001	-.05
Percent expenditures on student services	-.06	-.00219	-.07
Public four-year college	.04	.02	.07
Total enrollment	.04	-.00426	-.06
Peers: Percent majoring in other/non-technical	-.04	-.00047	-.03
Peers: Percent majoring in physical science	.03	-.00124	-.04
Peers: Percent Hispanic students	.02	.00078	.03
Private university	.04	-.01	-.04

(R=.35)

Table 5.36 (Continued)
Engineering Career: Recruits versus All others (N=11,224)

Variable	Simple r	b	Beta
College Experiences			
Took an essay exam	-.12	-.02	-.08
Took a multiple choice exam	-.07	-.01	-.08
Worked on a group project in class	.03	.01	.06
Hours per week: studying/doing homework	.05	.00237	.03
Gave a class presentation	-.05	-.01	-.04
Tutored another student	.05	.01	.03
Discussed racial/ethnic issues	-.05	-.01	-.03
Discussed course content with students	.03	.01	.03
Guest in professor's home	-.04	(-.01)	(-.03)
Participated in college internship program	-.00	.01	.02
(R=.38)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Finally, the freshman major also affects the likelihood that a student will be recruited into engineering. The positive effects on recruitment of students majoring in engineering, vocational/ technical fields, or physical science suggest that many undecided students were in fact inclined toward science and engineering from the beginning.

Living in a private room or apartment increases the likelihood of being recruited into engineering fields. Such arrangements may not only be more effective for studying and allowing students to concentrate on their work, but they may also serve to isolate the student from peers in other (competing) fields.

Similar to the finding for engineering majors, attending an institution which spends more money on student services or which has a more student-oriented faculty slightly decreases a student's chances of being recruited into engineering.

A number of environmental effects are associated with recruitment into engineering careers. Institutions with large percentages of science faculty and with large engineering programs (i.e., many peers majoring in engineering) are more likely to recruit students into engineering. However, consistent with the findings in Chapter 4, recruitment into engineering fields is negatively affected by attending an institution with a large physical science program.

A number of other peer environmental factors are associated with recruitment into engineering careers. Similar to the finding for engineering career persisters, students attending institutions in which many of their peers work full-time to pay for college are more likely to be recruited into engineering.

Positive environmental factors in recruitment include a strong institutional emphasis on resource acquisition and reputation enhancement, a peer group with high socioeconomic status, and attending a public four-year college. But perhaps the most intriguing environmental effects concern three environmental measures that have positive simple correlations with recruitment but which turn out in the regression analysis to have negative effects on recruitment: institution size, private university, and a peer environment characterized by high intellectual self-esteem. It is understandable that such institutions would have relatively large numbers of recruits (the positive simple correlation) simply because they are more likely than other types to have large engineering programs. But why should they have a negative effect on recruitment (the negative Beta coefficients)? Could it be that the student bodies of large private universities represent so many diverse career interest that some potential engineering recruits are lost to other fields? Could it be that a peer group with high intellectual self-esteem views engineering as too narrow or "applied" or "practical"? These admittedly speculative interpretations provides interesting challenges for future research on the effects of peer environments.

College activities positively associated with recruitment include: working on a group project for class, hours per week spent studying, tutoring other students, discussing course content with students, and participating in an internship program. While these activities may be the result rather than the cause of switching into an engineering career at some point during college, they also may act to reinforce the content of courses, thus instilling students with the academic confidence to switch their career plans to engineering.

Involvement measures negatively associated with engineering recruitment include taking an essay exam, taking a multiple choice exam, giving a class presentation, discussing racial and ethnic issues, and being a guest in a professor's home. Again, many, if not most, of these involvement measures are probably the result rather than the cause of being recruited into engineering.

Gender Differences in Recruitment

Because being female entered as a negative predictor of recruitment into engineering careers, additional regression analyses were performed separately by gender in order to gain an understanding of any differences among the factors associated with men's and women's recruitment into engineering (see Tables 5.37 and 5.38).

When only those variables that remain as significant predictors throughout the regressions are considered, the input variables predicting recruitment are remarkably similar for men and women. The only unique predictors for men are having a father who is an engineer and attending college to "learn more about things that interest me." For women, the only unique predictor is participating in a high school science contest.

Both men's and women's recruitment into engineering are positively affected by attending colleges with greater percentages of science faculty and high proportions of peers majoring in engineering. As was found for the overall sample, enrollment size has an interesting effect on recruitment into engineering careers: a positive simple correlation and a negative final Beta weight.

There appear to be only a few noteworthy differences between the college environments affecting men's and women's recruitment into engineering. A number of effects that were described for the overall sample actually appear to have an effect only for men: the peer "work" measure, peer intellectual self-esteem, resource and reputation emphasis, and the percent of degrees awarded in "other/non-technical" fields. Similarly, women's recruitment, but not men's, appears to be positively affected by attending a public four-year institution. One variable that did not entered the regression for the overall sample, but did enter for the women's sample, is attending an institution with over 80% men, which has a positive simple correlation but a negative effect on recruitment into engineering careers.

Table 5.37
Engineering Career: Recruits versus All others--Men (N=4,068)

Variable	Simple r	b	Beta
Background Characteristics			
Scientific orientation	.10	(.01)	(.04)
SAT-Math	.09	(.00)	(.04)
Used a personal computer in high school	.09	(.01)	(.03)
Father's career: Engineer	.07	.03	.04
Reason for college: Learn more about things that interest me	.06	.02	.06
Reason for college: Become a more cultured person	-.03	(-.01)	(-.03)
Reason for college: Parents' expectations	.03	(.01)	(.04)
Reason for college: Preparation for graduate school	-.01	(-.01)	(-.03)
Intended major: engineering	.26	.22	.26
Intended major: vocational/technical	.06	.05	.05
Intended major: physical science	.06	.03	.05
College Environments			
Living on campus	-.05	(-.02)	(-.04)
Faculty perception: student orientation	-.13	(-.00348)	(-.04)
Peers: Outside Work	.00	.04	.08
Faculty: percent in science	.15	(.00058)	(.03)
Faculty perception: resources and reputation emphasis	.11	.01	.07
Peers: intellectual self-esteem	.06	-.01	-.10
Peers: percent majoring in engineering	.20	.00145	.11
Undergraduate enrollment	.05	-.000002	-.06
Percent expenditures on student services	-.08	-.00238	-.06
Peers: percent majoring in other/non-technical	-.04	-.00088	-.04
(R=.36)			
College Experiences			
Took an essay exam	-.17	-.03	-.11
Took a multiple choice exam	-.09	-.03	-.11
Worked on a group project in class	.05	.02	.07
Discussed racial/ethnic issues	-.08	-.01	-.04
(R=.40)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Table 5.38
Engineering Career: Recruits versus All others--Women (N=7,156)

Variable	Simple r	b	Beta
Background Characteristics			
Scholar (personality type)	.06	(.00041)	(.02)
Participated in high school science contest	.06	.01	.03
Social Activist (personality type)	-.03	(-.00087)	(-.02)
Scientific orientation	.06	(.00179)	(.02)
Race: African American	.04	(.01)	(.02)
SAT-Math	.05	(.00002)	(.02)
Race: Puerto Rican	.03	(.04)	(.02)
Intended major: engineering	.25	.23	.24
Intended major: vocational/technical	.09	.09	.09
Intended major: physical science	.07	.02	.06
College Environments			
Faculty: percent in science	.11	(.00041)	(.04)
Peers: percent majoring in engineering	.13	.00092	.10
Peers: over 8.0% male enrollment	.03	-.08	-.05
Total enrollment	.00	-.00469	-.10
Public four-year college	.03	.02	.07
Percent expenditures on student services	-.03	-.00108	-.05
(R=.32)			
College Experiences			
Worked on a group project in class	.03	.01	.05
Took an essay exam	-.06	-.01	-.05
Took a multiple choice exam	-.04	-.00493	-.05
Tutored another student	.05	.00435	.04
(R=.33)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Summary of Findings

During the college years, there is a substantial decrease in the interest among both men and women in careers in engineering. Proportionately, male engineering majors outnumber female engineer majors by more than four to one; however, the proportionate decline of interest in this career is approximately equal for men and women. Students who defect from engineering head primarily towards careers in business, the military, computer programming, and scientific research. Most students who are recruited into engineering from other career choices during college are those whose initial career aspirations were undecided, or in business, computer programming, scientific research, or medicine. Apparently, many freshmen who say they are undecided but later switch to an engineering choice were interested in science or engineering when they first entered college, but simply undecided as to which particular science-oriented career (or engineering speciality) they would choose. There is also reason to believe that many of those who switch from this career choice from business to engineering were planning all along to major in science or engineering. These facts make it clear that most of the recruits into engineering careers come from other science-related fields.

Students whose aspirations for engineering careers persist during college differ from those who defect from engineering in that they tend to be more academically able, to have stronger scientific preparation, and are initially more committed to the field. Defectors from engineering display initial interests that extend far beyond engineering: they are more likely to say they enrolled in college to become more cultured or to broaden their horizons, and they attend institutions farther from home.

Persisters in engineering careers, compared to defectors, spend greater amounts of time studying, are less likely to hold part-time jobs, are more likely to have financial assistance to support themselves through college, and more often say that they came to college because of parent expectations.

In many ways, students who are recruited into engineering are very similar to those who persist. Engineering recruits exhibit greater academic ability and scientific preparation than non-recruits (i.e., those who maintain non-engineering choices throughout college). As with persisters, recruits are less likely than non-recruits to have a variety of interests outside engineering. Recruits are less prone to social activism and hedonism, and are less likely to be attending college in order to become more cultured. Instead, recruits are more likely to cite "to learn more about things that interest me" as a primary reason for coming to college.

Women, however, are significantly less likely than men to be recruited into engineering during college. Women are more likely to be recruited into engineering if they attend public four-year colleges and less likely to be recruited if they attend colleges where women comprise less than 2.0% of enrollment.

Parental influence also seems to play a role in recruitment into engineering. Men whose fathers are engineers or who came to college because of their parents' expectations are more likely to be recruited into engineering.

Engineering recruitment is less likely to occur in institutions which have a strong student orientation. Instead, recruitment is more likely where there is a large percent of science faculty, larger engineering departments, and a greater emphasis placed on resources and reputation enhancement. However, a physical science presence on campus has a negative effect on recruitment into engineering. Physical science majors, or students in schools with larger physical science departments, are less likely to be recruited into engineering during college. An interpretation of this finding relates to both the competition for students which exists between many physical science and engineering departments, as well as the prevailing academic elitism which favors the physical sciences over engineering. Indeed, campuses where students exhibit more intellectual self-esteem are less likely to recruit students into engineering.

Finally, students who are recruited into engineering are more likely to engage in college activities conducive to learning. Recruits spend more time studying, tutoring, discussing course content with other students, and doing internships, than students who are not recruited into engineering.

Overall, production of engineering persisters and recruits is enhanced through early scientific preparation, and through college experiences which allow students to become actively involved in the learning process. Yet, a large number students with the preparation and the ability to become engineers ultimately select other careers. It is the task of higher education to figure out how these potential engineers, with their varied interests, can be encouraged to remain in, and enjoy, engineering.

Summary of Findings, Conclusions, and Implications

In this chapter we have examined the overall net changes during college in the number of science majors and science career aspirants in greater depth by assessing and comparing the characteristics of four groups: persisters, defectors, recruits, and non-science students (those who never indicate an interest in science). Persisters and recruits tend to be better prepared in science when they enter college and to have had higher GPAs and higher test scores. Defectors and non-science students tend to differ from the other two groups in their values about life in general. For example, students who defect from physical science majors tend to place more value on personal goals that have to do with money and status. Early career indecision is also predictive of changes: more students who were initially undecided are found among both the recruits and the defectors.

Examining the majors and careers to which students defect, business as a major and as an ultimate career appears to be popular with the defectors from each of the science majors and careers we examined, but especially in engineering. Social sciences also attract high proportions of defectors from the natural sciences. However, there is also a good deal of interchange between the sciences and engineering: physical science defectors often choose engineering, and defectors from engineering majors often choose to major in physical sciences.

Students who are undecided with respect to majors or careers constitute a major source of recruits into the sciences and engineering. Most of these initially "undecided" recruits, however, show some interest in and talent for science when they start college.

Early commitment to an engineering career is clearly an important factor in whether students persist in their initial engineering career aspirations. Persisters are most likely to be those students who are initially more focused, are hard workers academically, and have very few outside diversions. Parental influences play a role as well: having a father who is also an engineer enhances the student's chances of persisting.

Women favor biological science majors over both physical science and engineering majors. Women are also much more likely than men to indicate science practitioner, rather than research scientist or engineer, as a career choice. Women are less likely than men to be recruited to engineering majors and to persist in research scientist careers, but they are more likely to be among the recruits to science practitioner careers.

Women are more likely to be recruited to engineering majors if they score high on the SAT-Math score and have a strong scientific orientation. Using a personal computer while in high school and having received tutorial assistance while in college also increases a woman's chance of becoming a recruit into an engineering major.

The influence of peers is apparent in both persistence and recruitment: the more peers there are majoring in a particular SME field, the greater the persistence in and/or recruitment into that field. These findings have direct implications for how we may wish to organize the college experiences of students. Basically, an effort needs to be made to encourage individual science students to have greater contact with others who share similar career interests.

Being around people with similar interests appears to reinforce one's own choices and interests in the same area. It should be added, however, that this peer effect varies across different SME fields: in the physical sciences, it appears to operate primarily on recruits, whereas in the biological sciences it operates primarily on persisters. In engineering it appears to affect both persisters and recruits.

The results also highlight the competition among various SME fields already noted in Chapter 4. Physical science departments play a key role here: having a large physical science program on the campus (a high proportion of students majoring in the physical sciences) appears to discourage recruitment into engineering careers and to reduce retention among biological science majors. These effects help to explain why the physical sciences experience smaller net losses during the undergraduate years: the stronger programs attract many defectors and potential recruits away from biology and engineering careers.

In short, these findings suggest that any strategy for increasing the number of students pursuing SME majors and careers should (a) consider whether to focus on retention, on recruitment, or on both retention and recruitment; and (b) take into account the possible effects of competition among SME fields.

Grants as a form of aid seem to be important for persistence in physical science fields. While smaller colleges appear to facilitate persistence in science, highly selective institutions tend to reduce it. It may be that strong competition discourages students from persisting in fields that are academically quite demanding.

Certain specific experiences in college may be important in determining whether students persist in or are recruited into science and engineering. Participating in research with faculty is positively associated with both retention and recruitment, especially among students who are uncertain about their careers and majors. Participating in honors programs also appears to benefit retention and recruitment. It may be that students in honors programs have closer contact both with faculty and with other science students.

Faculty behavior also seems to play an important role. Student-centered faculty appear to enhance students' persistence in biological sciences and encourage recruitment into careers in research. On the other hand, persistence in the physical sciences appears to be reduced by attending an institution where the faculty is heavily research oriented. This finding suggests that such faculty may be less involved in teaching and advising students. Students at such institutions probably get little support and encouragement from faculty role models.

Tutoring other students also appears to be a positive factor for persistence in science and engineering. This result suggests that institutions need to consider seriously the development of experiences where the more advanced students have opportunities to participate in the teaching of science to their classmates.

CHAPTER 6

Factors Influencing Acquisition of Scientific Knowledge and Quantitative Competency

Analyses reported in the preceeding two chapters underscore the importance of academic ability and achievement in the choice of science majors and careers: practically every regression identified one or more such measures (school grades, standardized test scores) as positive factors in the student's eventual choice of a college major or career in some field of science or engineering. Ability and achievement affect both persistence and recruitment.

In this chapter we attempt to identify these environmental factors that affect the development of mathematical competency and scientific knowledge during the undergraduate years. For these analyses the outcome measures consist of the students' performance on either of two nationally standardized tests used for admission to graduate and professional school: the Graduate Record Examination (GRE) Quantitative test and the Medical College Admissions Test (MCAT). Among other things, these tests measure analytical and problem solving skills as well as knowledge of scientific and mathematical content. These tests also represent important "gates" for entry into graduate and professional programs that lead to high level positions in science, medicine, and college teaching. As a consequence, developing undergraduate students' ability to perform well on these tests should be an important goal of any undergraduate program, especially one that includes scientific and mathematical content and which purports to prepare students for post-graduate study. In short, for reasons of both content and function, it is useful to know what kinds of undergraduate institutions and programs facilitate or inhibit the students' ability to perform well on such tests.

Since it is well known that students entering different kinds of colleges and programs already differ substantially in their performance on standardized tests, it was considered necessary to have available scores on similar college admission tests as input or "control" data. Thus, in addition to the questionnaire data already discussed, we were fortunate in being able to obtain from the College Entrance Examination Board and the American College Testing Program the college admission test scores of those 1985 entering freshman who completed the Fall survey in the Cooperative Institutional Research Program (CIRP).

Conversion of ACT to SAT equivalence was made possible by the existence of a subsample (N=14,865) for whom scores on both tests were available. Several analyses of these cases showed that it was possible to convert the ACT math score directly into the equivalent SAT math score, and that the sum of the other three ACT tests (English, social sciences, natural sciences) could be converted into an equivalent SAT verbal score. The SAT and ACT math scores correlate .85, and the SAT verbal and ACT verbal equivalent correlate .82. All 1985 freshman for whom we had both entering freshman questionnaire data and SAT (or equivalent ACT) scores were then matched against the files of the Educational Testing Service to obtain scores on the GRE. The unweighted mean scores of this sample (N=8,819) on both the SAT and GRE tests is quite high: mean SAT Verbal and Math of 537 and 573, respectively, and mean GRE Verbal and Quantitative of 533 and 590, respectively. Given that our sampling of institutions overrepresents the more selective institutions, and given that our sample of students includes only "fast trackers" who manage to take their GRE tests within four years after first entering college, one would expect this to be a highly select group of students. Nevertheless, it should be pointed out that the variability in test scores is only slightly less than the variability reported by ETS for its standardization population (Educational Testing Service, 1987a, 1987b). Thus, the standard deviations were 103 and 106, respectively, for the SAT verbal and SAT math (compared to 104 and 114 for the population), and 108 and 123, respectively, for the GRE Verbal and Quantitative test (compared to 118 and 132 for the population). The fact that the variability in test score performance in our sample has been only slightly constrained indicates that the correlations of these test scores with other variables will not be substantially attenuated by the select nature of our sample.

Scores on the MCAT were obtained from the association of American Medical Colleges. There was a total of 1,854 students for whom we had both 1985 entering freshman survey data, SAT or ACT data, and MCAT data. Regression results using the GRE Quantitative and Analytical tests and the MCAT tests are reported separately below.

GRE Quantitative Test Performance

The simple correlation between the SAT-Math and GRE-Quantitative is .85. Considering the four-year time lapse, this is indeed a remarkably high correlation. Clearly, these two tests, despite their different names, appear to be measuring very similar qualities. As a matter of fact, a "test-retest reliability" of .85 over a four-year time span would be remarkable, even if exactly the same instrument were used on both occasions.

Next to the SAT Math score, the strongest freshman predictor or the GRE Quantitative score four years later is the students' self-rating on mathematical ability. Apparently, this self-rating contains information about the student's mathematical skills not contained in the SAT math scores (partial Beta = .21). Other positive predictors that add significantly to the regression equation include the student's high school grades, SAT Verbal score, interest in making a theoretical contribution to science, fathers educational level, having a father who is an engineer, tutoring other students in high school, being undecided about a career choice, using a personal computer, number of physical science courses taken in high school, and having no religious preference. Negative input predictors include age, being a woman, being African American, giving "to improve my reading/studying skills" as a reason for attending college, being a non-citizen, interest in writing original works, asking high school teachers for advice after class, and three personality measures: Leadership, Artistic Inclination, Social Activism. That these three personality measures should negatively affect students' GRE quantitative scores is somewhat puzzling. One admittedly speculative possibility is that heavy engagement in these activities—student government, artistic pursuits, and social activism—consumes a lot of students' time and energy but does little, if anything, to enhance the development of quantitative skills.

As would be expected, majoring in science, engineering, or other technical fields facilitates the development of quantitative skills, whereas majoring in the arts or humanities has a negative effect. (These and other effects discussed below are assessed only after the effects of student input characteristics have been controlled). Majoring in science or engineering adds between 10 and 30 points to the student's GRE Quantitative score, depending upon whether one discounts the effect of other involvement variables that might be related to choosing a science and engineering career (below). Majoring in biological science, somewhat surprisingly, turns out to have a negative effect on GRE quantitative performance, even though the simple correlation between choosing a biological science major and a GRE quantitative score is positive. Once entering freshman characteristics are controlled (especially SAT math), the coefficient becomes negative. These findings suggest that many biological science majors once in college, may avoid courses that challenge their quantitative skills.

Financing college with personal savings is positively associated with GRE quantitative performance, whereas having need-based aid appears to have a negative effect.

Analyses using faculty environmental data involved some loss of cases (from 8,819 to 6,359) because not all institutions participated in the faculty survey. GRE Quantitative performance is positively affected by both the Intellectual Self Esteem of the peer group and the Research Orientation of the faculty. Other variables having positive effects include the size of the student body, the percent of Asians in the student body, and the use of written evaluations. Other faculty variables having positive effects include the percent of faculty in science fields, the faculty's perception that there is keen academic competition between students, and the institution's diversity emphasis. The percent of women on the faculty has a negative effect on GRE quantitative performance.

A much larger loss of cases (from 6,539 to 2,002) was necessitated in the analyses of "involvement" or "intermediate outcome" variables, since these variables come from the 1989-90 follow-up questionnaire. A number of these variables show significant partial correlations with GRE quantitative scores following control of student input and environmental characteristics. The strongest correlation involves the number of math/numerical courses taken in college. Here we have clear-cut evidence in support of the truism that "students learn what they study." The fact that taking writing skills courses has a negative effect on GRE quantitative performance is perhaps to be expected, although we do not find a similar pattern with math courses and GRE verbal performance (see Astin, 1993). In other words, taking math/numerical courses does not appear to impede the development of verbal skills in the same way that taking a lot of courses that emphasize writing seemed to impact negatively on quantitative skills. These contrasts may well reflect something about the modern college curriculum. Whereas all students are required to take at least some courses in the humanities and some courses that emphasize the development of verbal skills (reading, writing, speaking), it is possible in many institutions for those students whose interests lean heavily toward literature, language, the arts, and the humanities to avoid taking any courses that focus on the development of quantitative skills. Apparently, many students do just this. Clearly these findings have significant implications for curricular committees that may be concerned about the development of students' skills in quantitative reasoning and analysis.

Two other involvement variables show significant partial correlations with GRE Quantitative performance: college GPA and tutoring other students. The positive correlation with tutoring raises an interesting ambiguity: do students engage in tutoring merely because they have well-developed quantitative skills, does tutoring itself enhance the development of such skills, or both? That the students who have well-developed quantitative skills are more likely to end up tutoring other students in college is suggested by the fact that the simple correlation between tutoring and the GRE quantitative score diminishes considerably (from .14 to .03) when SAT math and other input and environmental characteristics are controlled. However, the fact that the correlation remains highly significant statistically, even after all other involvement variables are controlled, suggests that tutoring may indeed help to enhance quantitative skills. Similar theoretical arguments have recently been advanced to explain why cooperative learning seems to benefit all participants, regardless of their achievement levels (Johnson, Johnson, & Smith, 1991).

GRE Analytical Performance

While there was no entering freshman pretest score available for the GRE Analytical score, the fact that more than half of the variance in this score could be predicted from the SAT Verbal and Mathematical scores (R = .76) suggests that the SAT represents a fairly good pretest for the GRE Analytical. Other input characteristics having positive effects on GRE Analytical performance include being white, self-rated mathematical ability, using a personal computer, high school GPA, and two personality measures: Hedonism and Artistic Inclination. Negative input predictors include self-rated physical health, citing "to improve reading and study skills" as an important reason for attending college, being African American, and commitment to creating artistic works.

Gender produces interesting results in the prediction of the GRE analytical score. Women get much lower scores on the GRE analytical than men do, as evidenced by the simple correlation of -.20. The entry of SAT mathematical into the regression, however, changes this simple negative correlation to a significant positive partial correlation. This positive correlation survives through the entire regression, suggesting that some kind of direct positive effect of gender on analytical skills occurs during the undergraduate years. In other words, the reason why women get lower analytical scores is because they enter college with lower SAT Math scores than the men do. Once this differential in math preparation is controlled, being a women has a positive effect on GRE analytical scores. What this means is that women actually get higher analytical scores than one would expect from their SAT scores. The reason for this positive effect is not at all clear, but it provides interesting material for further studies on gender differences.

As would be expected, majoring in some field of physical science has a positive effect on GRE analytical scores. Other positive effects are associated with the use of graduate teaching assistants and the percentage of Hispanic students in the undergraduate student body. Conceivably, associating with a lot of TA's, many of whom would have taken the GRE relatively recently, may help undergraduates gain useful tips about preparing to take the GRE. As recent applicants themselves, the TA's could also serve to motivate the undergraduates by reminding them of the fact that their chances of being admitted will be enhanced by scoring well.

No faculty variables are found to be significantly correlated with GRE analytical performance, once the effects of input variables have been controlled. This negative result suggests that faculty teacher practices have very little effect on students' analytical competency.

Only three involvement variables are associated with GRE analytical score (following the control of input and environment variables): undergraduate GPA, hours per week spent socializing with friends (both positive correlations), and receiving personal/ psychological counseling (negative correlation). The positive effect of undergraduate GPA, which occurs with other standardized test scores (Astin, 1993), suggests once again that college grades, despite their relativistic nature, may indeed reflect cognitive learning.

MCAT Performance

The SAT Math and Verbal scores produce a multiple correlation of .76 with the MCAT, suggesting that the SAT is a reasonably good pretest for this test. The weights assigned to the two SAT scores were nearly equal in size (the weight for math was slightly higher), indicating that the MCAT is relatively evenly balanced between quantitative and verbal skills. Other entering freshman characteristics having positive weights in the prediction of MCAT scores include high school GPA, self-rated academic and mathematical abilities, and career indecision. Negative weights are associated with being a woman (the largest individual weight except for SAT scores), being African American, and being a non-citizen.

That entering college with plans to major in an allied health field carries a negative weight in predicting MCAT scores is a bit of a surprise. This result suggests that students who initially aspire to a career in allied health but then switch to a pre-med curriculum during college are at somewhat of a disadvantage in terms of their preparation to take the MCAT. Could it be that the basic science courses taken in connection with an allied health major are not as rigorous as similar courses taken in a traditional liberal arts program?

The environmental variable having by far the strongest effect on MCAT scores is the peer measure, Intellectual Self-Esteem. Why should the intellectual self-esteem of the peer group facilitate performance on both the MCAT and GRE tests? There are at least three possible (and not mutually exclusive) interpretations. First, being around a lot of other highly able, self-confident, and motivated students may stir up the individual student's competitive inclinations. Second, verbal interactions among such students may often involve the exchange of information and ideas that are useful in taking these standardized tests. In other words, such students may represent good "teachers" for one another. Finally, since students with high intellectual self-esteem are likely to take graduate admissions tests, there are more individual students in such an environment from whom to learn "tricks of the trade" in preparing to take such tests. Other variables having positive effects on MCAT scores include paying for college expenses with personal savings and the percent of Asians in the undergraduate student body. It is interesting to note here that being Asian-American as such does not show any significant effects on either the GRE or the MCAT, even though attending a college with a relatively high proportion of Asians in the student body positively affects performance on both tests. Apparently, this peer group measure affects Asians and non-Asians alike. The only negative effects on MCAT scores are being supported by a college work/study grant and attending a college for women.

Studying the effects of faculty environmental variables necessitates a slight loss of students (from 1,854 to 1,785). The strongest effect by far is associated with the faculty perception of "keen competition" among undergraduate students for grades. This perceptual variable, incidentally, is strongly associated with the Intellectual Self-Esteem of the peer group (r =.71). As a matter of fact, at the step where "keen competition" enters the regression, the partial regression coefficients for the two variables are virtually identical (both coefficients equal .13). But when "keen competition" enters the regression, the coefficient for Intellectual Self-Esteem is diminished considerably. In effect, then, there is little to choose between these two variables when it comes to their effects on MCAT scores since the difference in their partial Betas at the step where "keen competition" enters is insignificant.

The only faculty environmental variable showing positive effects on MCAT performance is the percent who teach interdisciplinary courses. Two faculty variables have negative effects on MCAT performance: the average age of the faculty and the perception that faculty colleagues are positive about the institution's general education program. In these faculty analyses, two other institutional characteristics entered the regression equation with negative weights: attending a public university and the percent of total expenditures devoted to instruction.

Analyses involving the possible effects of involvement variables on MCAT performance required a much reduced sample size (n = 502), since it was necessary to have follow-up questionnaire data as well as all of the data required for the faculty analyses. The involvement measure with by far the strongest correlation with MCAT performance (after the effects of input and environmental characteristics are controlled) is undergraduate GPA (partial Beta = .22). Three other involvement variables have negative associations with MCAT performance: received personal/psychological counseling, hours per week spent attending religious services, and hours per week spent with student clubs or organizations.

Summary and Discussion

These analyses of factors affecting students' performance on nationally stanardized tests of skill and knowledge in math, analytical thinking, and science yield several consistent patterns. To begin with, much of the variance in performance four years after entering college can be attributed to preexisting differences at the point of college entry. Among other things, this result highlights the importance of precollegiate preparation: to a large extent students' performance at the time of graduation from college is constrained by precollegiate preparation, regardless of what happens in college.

Findings regarding other precollegiate (input) factors are a cause for concern. That African American students perform less well on the graduate admissions tests than would be expected from their college admission test scores suggests that their undergraduate educational experiences are not enhancing their scientific knowledge and mathematical skills to the same extent as is found with members of other racial/ethnic groups. Thus, the substantial gaps in performance between African American and other students that already exist at the time of college entry are actually widened during college.

A similar scenario characterizes the results for women. Performance gaps favoring men at the point of college entry appear to widen during the undergraduate years, as reflected in performance on the GRE Quantitative test and MCAT. A notable exception here is the GRE

Analytical test, where women actually perform better than do men with comparable SAT scores at college entry.

As fas as environmental factors are concerned, many of the findings seem to support the argument that the key to enhancing students' performance on standardized tests is competitiveness. Scores on both the GRE Quantitative and MCAT tests appear to be enhanced by exposure to a peer group with high intellectual self-esteem and "peer competition" among students. That performance on these two tests is also positively affected by exposure to a peer group that includes a high proportion of Asian Americans and negatively influenced by a peer group that includes large proportions of women could also reflect the effects of competitiveness. Asian Americans, for example, tend to excel in math and science. Women, on the other hand, tend to perform less well than men do on tests of mathematical and scientific knowledge. Moreover, in a study which compared the environments of men's colleges with those of women's colleges (Astin, 1968), the single factor showing the greatest differentiation was "competitiveness" (men) versus "cooperativeness" (women).

There are, of course, other possible interpretations of these patterns. As suggested earlier, peer groups that are high in intellectual self-esteem (as well as peer groups with large proportions of Asian Americans and small proportions of women) would be likely to include many students who are interested in science and math and who intend to pursue postgraduate study. Simply affiliating with such a peer group for four years may well provide the student with a more "science-oriented" experience which could add something to his or her scientific and mathematical knowledge through informal conversations, co-curricular activities, and other out-of-class experiences. Furthermore, exposure to such a peer group would also enable the student to acquire more "tricks of the trade" in preparing for graduate and professional school admissions tests.

That GRE Quantitative performance is also enhanced by attending a college where a high proportion of faculty are in SME fields raises an interesting question concerning the undergraduate curriculum. Could it be that the general education curriculum in such institutions is more heavily weighted toward math and science, simply because of the influence that can be brought to bear by the sizable contingent of science-oriented faculty?

One possible policy conclusion to be drawn from these results relates to the old practice of "tracking." A simplistic application of the results would recommend segregating students with strong science interests and high intellectual self-esteem from other students. While such a practice might well enhance the test performance of these elite students, what about the math and science competency of all the other students? The reader should also be cautioned that predicating any educational policy or practice simply on studies using standardized tests as the measure of educational outcomes can be risky. In fact, with the exception of the intellectual self-esteem of the peer group, the environmental factors that seem to enhance performance on standardized tests appear to be very different from the factors that enhance performance on a variety of other important cognitive and affective outcomes, including undergraduate degree completion and enrollment in graduate or professional school. The environmental factors that seem to enhance standardized test performance are also very different from those that affect the students' interest in science (see the preceding chapters).

CHAPTER 7

Undergraduate Degree Aspirations and the Transition to Graduate School

One of the most important aspects of the career development of scientists is the acquisition of an advanced degree. Entry into research and university teaching careers is strongly dependent upon earning a doctorate in an appropriate field. Postgraduate study is also mandatory for those seeking to enter one of the science–practitioner fields, although an advanced professional degree is of primary importance for these fields. The field of engineering, of course, represents a departure from this pattern, but there are increasing pressures for students to pursue postgraduate education in this field as well.

Given the importance of pursuing postgraduate studies for those in science and science–related fields, degree aspirations are an important consideration in understanding how colleges help to promote undergraduate science achievement. Students interested in science as a subject matter, for example, may find themselves excluded from science careers because their aspiration for advanced study declines. Science students may find themselves bored or otherwise "turned–off" in college, and choose not to seek further study (or pursue studies in a different field during graduate school). Financial considerations, both in terms of direct educational costs and potential economic rewards upon graduation, may also influence interest in graduate and professional education.

This chapter examines two important outcomes of undergraduate science education. First, the degree aspirations of undergraduates are considered through descriptive and causal analyses. Patterns of degree aspirations during the collegiate years are examined, as are differences among students in science and engineering fields. The transition to graduate school is then considered, with a focus on preferred postgraduate fields of study. Given the four year span of time covered by the current follow–up survey, we cannot examine the question of graduate school performance with these data. We can, however, study changing patterns of preference and aspirations toward postgraduate study. A related topic, performance on graduate admission examinations, has already been considered in Chapter 6.

Patterns of Change and Stability in Degree Aspirations among Undergraduates

Table 7.1 shows the degree aspirations of students within our follow–up sample. These data show that upon entry into college, nearly two–thirds (63 percent) of the 1985 entering freshmen aspired to some form of postgraduate study, and that more than one in four (29 percent) aspired to a doctorate or advanced professional degree. While these figures may seem high, they are consistent with the long–term trend toward high degree aspirations among college freshmen, and do in fact represent a substantial increase in aspirations as compared to college freshmen in the 1960s and early to mid–1970s (Dey, Astin, & Korn, 1991).

Four years after entering college, the students in the follow–up sample still express very high degree aspirations, with about 7 in 10 students (71 percent) being interested in seeking postgraduate degrees. Despite the maintenance of a high level of interest in seeking advanced degrees, there are significant shifts in aspirations toward specific degrees. Interest in MA, PhD, and JD degrees increased during the four years after entering college, while interest in medical degrees dropped by more than one–half. This pattern of declining interest in pursuing a medical degree is consistent with the sharply declining popularity in aspirations for a career in medicine (Chapter 3).

While it is clear from Table 7.1 that students enter college with and maintain high degree aspirations, what changes occur? In other words, where do students with particular freshmen degree aspirations "end up"? Table 7.2 shows entering degree aspirations crosstabulated with 1989 degree aspirations. Each row in the table displays the percentages of students who end up aspiring to a certain degree four years later. This table clearly shows a trend toward maintained or increased aspirations regardless of entering aspiration levels. For example, 66 percent of the students entering college aspiring to an Associate's degree report having aspirations for a Bachelor's or Master's degree four years later. Only 13 percent of these students maintained their original aspiration for an Associate's degree, while about 1 in 10 (11 percent) had no degree aspirations after four years. A similar pattern can be seen for students entering seeking a Bachelor's degree.

Table 7.1
Degree Aspirations, 1985 and 1989 (1985 N = 20,322; 1989 N = 22,109)

	Aspirations reported in		Relative percent change
	1985	1989	
None	.6	2	167
Associate[1]	.4	.7	75
Bachelor's	22	18	-21
Master's	33	40	24
Ph.D. or Ed.D.	14	17	26
Medical[2]	10	5	-52
Law[3]	5	8	56
Other[4]	1	3	136
No response	14	7	-54

[1] Includes those responding 'Vocational certificate'.
[2] MD, DO, DDS, and DVM.
[3] LLB and JD.
[4] Includes those responding 'Other' and 'Divinity (BD and MDiv)'.

Table 7.2
Changes in Degree Aspirations (N = 19,115)

1985 Degree Aspirations	1989 Degree Aspirations								
	None	AA	BA	MA	PhD	Medical	Law	Other	N
None	5	2	28	36	15	3	5	7	131
Associate[1]	8	13	32	34	6	1	1	5	85
Bachelor's	3	2	34	46	9	1	4	3	4,852
Master's	1	1	16	53	18	1	7	2	7,299
Ph.D. or Ed.D.	1	0	9	33	42	5	8	3	3,109
Medical[2]	1	0	9	24	20	34	10	3	2,194
Law[3]	1	0	7	25	14	1	50	2	1,206
Other[4]	3	—	20	41	14	1	10	11	239
All students	2	—	18	43	19	5	9	3	19,115

Note: Percentages total in the row.

[1] Includes those responding 'Vocational certificate'.
[2] MD, DO, DDS, and DVM.
[3] LLB and JD.
[4] Includes those responding 'Other' and 'Divinity (BD and MDiv)'.

The percentages for PhD, medical, and law degrees are somewhat more complicated, in that there is a degree aspiration "ceiling": a student can't aspire to a degree higher than that which is offered. This may help explain the one–quarter to one–third of the students who initially entered college seeking a terminal degree but who ended up aspiring to a Master's degree—if the plans of these students change, they have nowhere to go but down in terms of aspirations. Changing patterns of interest in different fields probably contributes to the interest in Master's degrees as well, since the field of business attracts many majors during the undergraduate years (which, for many of these students, translates into an aspiration for an MBA). It is interesting to note that of the three terminal degrees, the PhD gains the most from changing aspirations (although in all cases, the Master's degree attracts the most interest among those who changed). It is likely that faculty role models increase the visibility of the PhD—and occupations requiring a PhD—thereby helping to attract students who initially aspired to terminal professional degrees.

Students initially seeking Master's degrees are, as a group, the most consistent in their aspirations: More than one–half (53 percent) maintained their aspirations during the four years we studied. Law degrees retain the interest of nearly as many students (50 percent), while interest in receiving a PhD is maintained by about four out of ten students (42 percent). Of the degrees at the baccalaureate level and higher, medical and Bachelor's degrees have the worst ability to maintain aspiration level: Only about one–third of the students in each of these two groups maintained their aspirations (although in the case of the BA this trend is caused by heightened aspiration levels).

How do degree aspirations change for science and engineering students? The answer to this question can be found in Table 7.3, which shows changing aspiration patterns by undergraduate major. The first grouping of data shows changing aspiration patterns for those students who entered aspiring to a Bachelor's degree. There are some revealing patterns of change across the major fields considered. For example, one out of every ten biological science students ended up aspiring to a medical degree after four years, as compared to an average of one in a hundred (or less) among the other majors. Clearly, the environment within the biological sciences encourages students to seek medical degrees regardless of entering aspiration levels. The biological and

Table 7.3
Changes in Degree Aspirations By Major Fields

1985 Degree Aspirations	1989 Degree Aspirations					
	BA	MA	PhD	Medical[1]	Law[2]	N
Bachelor's degree						
Biological sciences	42	32	13	11	1	234
Physical sciences	40	44	15	1	0	296
Engineering	38	53	8	0	1	494
All other fields	36	49	9	0	4	3,828
Master's degree						
Biological sciences	17	39	25	16	2	310
Physical sciences	14	58	26	1	1	448
Engineering	21	57	17	1	3	1,033
All other fields	18	55	18	1	8	5,508
PhD or EdD						
Biological sciences	11	17	37	33	2	444
Physical sciences	8	27	60	3	1	401
Engineering	12	46	36	2	4	419
All other fields	11	36	41	2	11	1,848
Medical degree[1]						
Biological sciences	9	14	13	62	2	1,499
Physical sciences	7	15	36	40	3	142
Engineering	13	30	18	33	6	79
All other fields	14	32	23	15	16	474

Note: Tabulations based on FUSALL sample. Percentages total in the row. Aspirants to AA, vocational certificates, and other degrees excluded.

[1] MD, DO, DDS, and DVM.
[2] LLB and JD.

physical sciences also seem to 'convert' the interest of one in seven baccalaureate students (13 and 15 percent, respectively) to the PhD, in comparison to less than one in ten for engineering and the other major fields. Despite their relative lack of interest in PhDs, baccalaureate engineering students also have increased degree aspirations: Over one–half (53 percent) are interested in Master's degrees four years after entering college.

Turning now to the students who entered college aspiring to a Master's degree, we see that students in the biological sciences are the least likely to maintain their entering aspiration. Once again, medical degrees are very attractive to these students, and the result is a sharp decline in interest in a Master's degree. As with the trends found among entering baccalaureate aspirants, we see a relatively large number shifting to the PhD four years later, especially among those in the biological and physical sciences.

Among those students who enter college aspiring to the PhD, we see that students in the physical sciences are most likely to maintain their aspirations. In comparison to students in the biological sciences and engineering, students in the physical sciences are about 80 percent more likely (37 and 36 percent, respectively, versus 60 percent) to still aspire to a PhD after four years. For those in the biological sciences, the medical degree is the main recipient of those defecting from the doctoral ranks, while the master's degree is the main recipient for engineering students. It may be that as students become more knowledgeable about career paths in engineering, they are more likely to adjust their aspirations downward toward traditional career paths.

Aspirations for medical degrees again show how different the culture is in the biological sciences. Six out of ten biological science students maintained their aspirations for medical degrees, which is one–third more than that found among the physical science students (62 percent versus 40 percent). If students change their mind about the MD, to what degrees do they end up aspiring? Again, we see a clear differentiation between the patterns in the science and engineering fields. Students in the biological sciences who abandon their aspirations for the MD are evenly split between the MA and the PhD. In contrast, physical science students who defect tend to prefer the PhD as a secondary option by about two to one over the MA (36 versus 15 percent). Engineering students show the reverse pattern, preferring instead to seek the MA. These changes clearly reflect not only the changing preferences of students in these fields, but also the traditional career paths in these fields.

What do these changing aspiration patterns tell us? First, they tell us that students' aspirations are high upon entry into college, and they remain high during the college years. While their aspirations are largely consistent with their career choice patterns, much of this may also be attributed to generally high achievement levels. The data also reveal some interesting patterns of change. These patterns tell us something about career paths and disciplinary cultures, as well as raise some interesting policy questions. For example, there appears to be a strong orientation toward medicine among the students who are majoring the in biological sciences. If faculty respond to this orientation, what implication does this have for general science education? Are the introductory courses aimed at meeting the needs of future scientists, do they seek to prepare students for medical careers, or is general scientific literacy the goal in these departments? If students are 'tracked,' which track gets the best teachers?

Student Background and Environmental Characteristics Related to Gains in Degree Aspiration

Although there are some interesting patterns found in the descriptive data presented above, our interest now turns to the question of what environmental characteristics influence patterns of students' degree choices. To answer this question, we will employ the analytical technique described in Chapter 2 and elsewhere in which entering student characteristics are statistically controlled prior to examining potential environmental impacts.

In defining the dependent variable for these analyses, we recoded the 1985 and 1989 degree aspirations into the following five–point ordinal scale:

1. None
2. Associate degree or less
3. Bachelor's degree
4. Master's degree (including divinity degrees)
5. PhD, EdD, medical, and law degree

Although there are obvious and distinct differences between the doctorate, medical, and law degrees, there is not a clear hierarchy of aspirations among them. Since they all represent terminal degrees in their respective fields, we shall consider them as one for regression purposes.

Separate regression analyses were conducted for the science and engineering students, and the results were similar to those found in the regression for the entire student sample. This suggests that the factors that influence students' aspirations are similar for all students, regardless of their field of study. Given the added stability in the larger all–student sample, the results presented below are based on this larger analysis. Similarly, since gender did not enter as a significant predictor of degree aspirations, separate gender analyses were not conducted.

Freshman predictors

What entering characteristics predict degree aspirations four years after entering college? The fact that the pretest measure of degree aspirations in 1985 has only a modest correlation of .35 with 1989 aspirations suggests that there is a great deal of switching among the individual students surveyed in 1985 and 1989 (which we have already discussed). What other entering characteristics are associated with these changes in aspirations? Table 7.4 shows that by far, the largest weights are associated with the following three input characteristics: intellectual self–esteem, SAT verbal score, and attending college 'to prepare for graduate or professional school.' Substantial positive weights are also associated with socioeconomic status, having an orientation toward social activism, being African American, and having high school grades. Other positive (but weaker) predictors include being oriented toward feminism, tutoring other students in high school, the number of biology courses taken in high school, being oriented toward status striving, having as an important reason for attending college 'to make me a more cultured person,' having a father who is a physician, and the number of physical science courses taken in high school.

Environmental effects

After first controlling for differences in student input characteristics, we are now in the position to begin looking at the effects of the college environment. Table 7.5 shows those effects that are associated with initial campus environments (i.e., those that are known at the point of freshman entry). Initial environmental variables that are associated with increased degree aspirations include planning on majoring in the social sciences, education, and the biological sciences. Although majoring in education has a simple correlation with 1989 degree aspirations which is negative, the correlation becomes significantly positive when input variables (such as SAT verbal, socioeconomic status, and high school grades are controlled). Pre–law and pre–medical

Table 7.4

Relationship of Significant Student Input Characteristics with Degree Aspirations in 1989

(FUSMAX sample, n = 14,339)

	Simple *r*	β on entry into the equation	β at final input step
Degree aspiration (1985)	.35	.35	.19
Intellectual self-esteem	.26	.17	.05
Verbal ability (SAT-V)	.24	.12	.11
Reason for college: Prepare for graduate school	.28	.13	.11
Socioeconomic background	.18	.07	.07
Orientation toward activism	.14	.07	.07
Student's race: Black	.04	.06	.07
High school grade point average	.19	.07	.04
Orientation toward feminism	.10	.05	.04
High school activity: Tutored another student	.17	.05	.04
Years of high school study: Biology	.07	.04	.04
Orientation toward status striving	.01	-.04	-.04
Reason for college: To become more cultured	.11	.03	.03
Years of high school study: Physical sciences	.12	.03	.02
Father's occupations: Physician	.09	.03	.03
Rank in high school class	.16	.03	.03
Born-again Christian	-.05	-.03	-.03
Life goal: Write original works	.10	.02	.02
Was depressed in high school	-.03	-.02	-.02
High school activity: Performed volunteer work	.10	.02	.02

students are also likely to increase their degree aspirations, as are those who enter college with an interest in being research scientists. On the other hand, students in engineering, business, and other fields are likely to decrease their aspirations over time. Students who live at home or in private off–campus housing are also likely to decrease their aspirations, suggesting that immersion in the campus environment [through housing or activities] is an important contributor to promoting high degree aspirations.

Table 7.5
Initial Environmental Effects on Degree Aspirations in 1989 (FUSMAX sample, n= 14,339)

	Simple *r*	β after control of input variables	β at final step of current block
Freshman major choice: Social sciences	.12	.05	.05
Freshman major choice: Engineering	-.03	-.04	-.03
Freshman major choice: Business	-.14	-.04	-.03
Freshman major choice: Other fields	-.07	-.02	-.02
Freshman major choice: Education	-.03	.03	.03
Freshman major choice: Biological sciences	.10	.03	.02
Freshman career choice: Lawyer	.13	.04	.04
Freshman career choice: Physician	.17	.04	.05
Freshman career choice: Research scientist	.08	.03	.03
Freshman residence: At home or with relatives	-.10	-.04	-.03
Freshman financial aid: State scholarship	.02	.03	.02
Freshman residence: Private off-campus housing	-.02	-.02	-.01

The data in Table 7.6 shows that the most potent environmental variable influencing students' degree aspirations is the Humanities Orientation of the faculty. The Humanities Orientation of the faculty represents the degree to which faculty embrace a traditional liberal arts program. The small, highly selective colleges exhibit the strongest orientations toward the humanities, while the larger, nonselective institutions show the weakest. It may be that by embracing these values, faculty help provide role models for staying part of the academic system. Attending a college where the students have high levels of science preparation, and where the faculty are student–oriented also helps promote increased aspirations.

The size and consistency of the effect of Humanities Orientation on degree aspirations can be seen in Table 7.7. Regardless of the student's initial level of degree aspirations in 1985, the Humanities Orientation has a consistent positive effect: with each increasing level of Humanities Orientation, higher proportions of students indicate in 1989 that they plan to obtain the doctorate or advanced professional degrees. Without exception, the percent of students aspiring to advanced

Table 7.6
Environmental Effects on Degree Aspirations in 1989 (FUSMAX sample, n= 14,339)

	Simple *r*	β after control of input variables	β at final step of current block
Humanities orientation of faculty	.19	.09	.06
Peer environment: High level of science preparation	.18	.05	.06
Student orientation of faculty	.08	.07	.05
Percentage of faculty who are women	.04	.05	.03
Peer environment: Level of outside work	-.12	-.04	-.03
Faculty relations with students	-.17	-.05	.03
Major dominated curriculum	.02	-.01	-.02

Table 7.7
Effect of Humanities Orientation on Aspirations for Advanced Degrees (unweighted data)

1985 Degree Aspiration	N	Percent aspiring for advanced degrees[a] in 1989 by level of institutional humanities orientation			
		Very low (N=4,356)	Low (N=5,088)	High (N=4,782)	Very high (N=4,758)
Doctorate or Advanced Professional	6,509	46	58	61	66
Master's	7,349	21	23	27	35
Bachelor's	5,041	10	13	15	19
None or less than Bachelor's	216	11	16	19	38

[a] PhD, EdD, MD, DO, DDS, DVM, JD, BD, or MDiv.

degrees, at every level of initial degree aspiration, increases with each increasing level of Humanities Orientation. Interestingly enough, this may well be, in part, a peer group effect, since the percent of *freshmen* aspiring to the doctorate or advanced professional degrees increases regularly with each increasing level of Humanities Orientation: 25, 29, 35, and 48 percent of freshmen, respectively, entering institutions with very low, low, high, and very high Humanities Orientation.

Effects of involvement

A number of involvement measures are significantly associated with degree aspirations, after first controlling for the effects of entering student and environmental characteristics (Table 7.8). Most potent among these is the student's undergraduate GPA. While we cannot be absolutely certain about the direction of causation involving GPA, it certainly seems likely that the student's undergraduate grades can influence their plans for further education (Drew & Astin, 1972). A number of other involvement measures highlight the importance of student–faculty interaction in

Table 7.8
Student Involvement (intermediate outcomes) and Their Effects on Degree Aspirations in 1989
(FUSMAX sample, n= 14,339)

	Simple *r*	β after control of input variables	β after environments	β at final step
College grade point average	.27	.19	.17	.13
Hours per week: Talking with faculty outside class	.18	.13	.10	.04
Took interdisciplinary courses	.24	.13	.09	.05
Left college	-.20	-.15	-.09	-.07
Work on professor's research project	.19	.11	.09	.06
Took essay exams	.20	.13	.09	.05
Tutored other students	.17	.11	.10	.05
Discussed course work with other students	.18	.12	.09	.04
Participated in college honors program	.25	.12	.10	.04
Had group projects in class	.00	.03	.01	-.04
Participated in organized demonstrations	.17	.08	.06	.03
Hours per week: Studying	.17	.09	.07	.03
Had faculty critique paper	.19	.12	.09	.03
Socialized with someone of different racial group	.15	.07	.05	.03
Hours per week: Hobbies	-.04	-.03	-.02	-.02
Number of years in school	.16	.10	-.03	-.03
Got married during college	-.09	-.05	-.03	-.02
Worked full-time during college	-.07	-.04	.00	.02

raising students' degree aspirations: hours per week spent talking with faculty outside of class, working on professors' research projects, and having class papers critiqued by instructors. Other positive correlates of degree aspirations include enrolling in interdisciplinary courses, taking essay exams, tutoring other students, enrolling in honors programs, participating in campus demonstrations, socializing with students from different racial/ethnic groups, number of science courses taken, and number of history courses taken.

These findings stress the importance of many different kinds of involvement in promoting heightened degree aspirations. Students who do well in school, are actively engaged in academic and co-curricular activities, and who are challenged by their teachers and their course work are likely to want to continue on. Together with the environmental findings related to the humanities and student orientation of faculty, these results suggest the importance of an environment and a process that is conducive to learning. It may be that at institutions which are characterized by such conditions, the so-called 'hidden curriculum' is not so hidden. In these cases, rather, it is self-evident.

The Transition to Graduate School and the Choice of a Field of Study

Although aspiring to postgraduate study is an important element of science training, the proof of the pudding is in the eating: which students actually enroll? In order to get a sense of the ways in which students in the sciences implement the transition to graduate school, we will in this section examine postbaccalaureate educational activities as well the choice of a graduate field of study.

What plans do the students in our sample have for the fall of their fifth year since entering college (Fall, 1989)? Table 7.9 shows that while about one–half of the students (51 percent) plan on working full–time, an equal number plan to continue their education. About one–third of the sample (32 percent) reported that they planned to continue their undergraduate studies on either a full– or part–time basis, while about one in five (19 percent) planned to attend graduate or professional school. The split between plans for undergraduate and graduate study is

Table 7.9
Plans for Fall of Fifth Year After College Entry (Fall, 1989)

Anticipated activity	Percent
Attending undergraduate college full-time	27
Attending undergraduate college part-time	5
Attending graduate or professional school	19
Attending a vocational training program	.7
Working full-time	51
Working part-time	21
Serving in the Armed Forces	2
Traveling, hosteling, or backpacking	6
Doing volunteer work	9
Staying at home to be with (or start) my family	5

Notes: Tabulations based on FUSALL sample. Percentages total more than 100 due to multiple responses.

probably related to the increased amount of time—relative to past decades—it takes contemporary students to earn a bachelor's degree. Previous research (see for example, Dey & Astin, 1989) has shown that retention rates have dropped dramatically over the past 25 years. This decline may be due to changing levels of preparation and patterns of financial support (e.g., more part–time work versus grants), but regardless of the correct explanation, these data show that for many able students the myth of the four–year degree is simply that.

Are plans for future education similar for all types of students? Table 7.10 shows how plans for study vary by college major. Biological sciences are the most likely to immediately make the transition to graduate school, with over four out of every ten planning on making the jump immediately. The percentage of students in physical science continuing on directly is also relatively high (31 percent versus an overall average of 19), and these high numbers are probably a reflection of several things: relatively high incoming levels of preparation among the students, coupled with a strong desire and need for postgraduate study.

Table 7.10
Plans to Attend Graduate School in Fall, 1989, by College Major

Major field	Percentage
Biological sciences	41
Physical sciences	31
Psychology	26
Health professions	25
Social sciences	24
Humanities	22
Engineering	18
Arts	14
Other	12
Education	12
Architecture	12
Business	8
Nursing	3
Undecided	2
Total	19

Note: Tabulations based on FUSALL sample.

Engineering students are about average in terms of their plans to continue directly on into graduate school. In comparison to other fields, two factors may be at play. First, regardless of entering preparation level, many engineering programs operate on a de facto five–year plan making it unlikely that many will be eligible to continue directly into graduate school. As a practice–oriented field, many graduate engineering programs see it is a plus to have some work experience prior to receiving advanced training, thereby making it less attractive to continue directly on (at least on a full–time basis).

Table 7.11 gives us a sense of such field–based variations, which shows these transition patterns in much more detail. The first column in Table 7.11 shows us the percentage of students who planned at the time of the follow–up survey to continue undergraduate work in the Fall of 1989. These percentages range from a high of 67 percent for architecture [although the popularity

Table 7.11
Scheduling of Plans for Future Educational Pursuits, by College Major

		Of not continuing with undergraduate studies in Fall 1989, the percentage who			
Major field	Continue undergraduate work[1]	Plan to begin graduate studies, Fall 1989	Plan to return to school later[2]	Have no plans to return[3]	Total N
Architecture	67	—[4]	—[4]	—[4]	124
Arts	41	26	20	54	740
Biological sciences	30	61	8	31	1,867
Business	37	15	26	59	3,743
Education	41	24	35	42	1,791
Engineering	47	37	17	47	1,914
Health professions	38	45	16	39	302
Humanities	28	33	21	46	3,134
Nursing	42	8	35	57	340
Other	42	25	23	52	3,733
Physical sciences	29	46	13	41	1,509
Psychology	28	39	18	42	1,360
Social sciences	24	34	17	48	2,827

Notes: Tabulations based on FUSALL sample.

[1] Includes those planning additional undergraduate work in Fall, 1989.

[2] Defined as those who aspire to a degree higher than that currently held, and who do not plan graduate studies or additional undergraduate work in Fall, 1989.

[3] Defined as those who do not aspire to a degree higher than that currently held.

[4] Not reported due to small N.

of 5–year architecture program may account for this high figure] to a low of 24 percent for the social sciences. Both the biological and physical sciences have relatively low percentages of fifth–year students, which is most likely due to relatively high entry preparation and short time–to–degree. Engineering students, in contrast, have one of the highest percentages of fifth year students (47 percent). This, as noted above, is likely due to the five–year structure of many engineering programs.

Columns 3 through 5 in Table 7.11 show the percentages of those students who were not planning on additional undergraduate work in Fall, 1989 in each of three mutually–exclusive categories of future educational plans. Column 3 shows the percentage who plan to enter graduate school directly, column 4 shows the percentage of students who plan to enter later, and column 5 shows those students who have no further educational plans.

Column 3 shows how students in the sciences and the health professions are the most likely to continue directly on into graduate or professional school. Six out of every ten biology students plan to enter graduate or professional school in the fall of the fifth year, while slightly under half of the physical science students (46 percent) plan to do the same. Forty–five percent of the students majoring in the health professions plan to continue on directly. Engineering, by way of contrast, sends 37 percent of its students directly into graduate school. Business and nursing students are the least likely to continue directly on (15 and 8 percent, respectively).

Turning now to the percentages of students planning to return later (column 4), we see that the sciences (and the health professions) have relatively low numbers of students planning to continue on later. This suggests that if students in the sciences do not continue on directly, they are unlikely to ever plan to continue on. Fields such as education and nursing have, in contrast, large numbers of students planning to continue on in the future. In large measure, of course, this is due to the reality of advancement in those fields, which is dependent upon experience as well as education.

Business, nursing, and the arts are fields with very high percentages of students planning no postgraduate work (59, 57, and 54 percent respectively). Biological science has the smallest number of students planning no postgraduate study (31 percent), while physical science has a slightly higher percentage in this category (41 percent). About one–half of the engineering students plan no future studies.

Now that we've considered the timing of plans for future study, we will examine the question of field of study. This question can be phrased in two different ways: What are the graduate field destinations of different undergraduate majors, and what are the undergraduate major sources of graduate students in various fields? These two questions will be considered in turn, with the question addressing sources being limited to science fields.

Table 7.12 presents a simplified version of a 'destination' table similar to the one presented in Chapter 3. In it, we display the percentages of students planning graduate study in the same field of final undergraduate major. In addition, we display the percentage of students from various fields planning on graduate study in business, as it is a major field of study at the graduate level. The percentages remaining in the same fields (column 1) show a great deal of variation, ranging from 90 percent in business to 38 percent in the social sciences. The sciences and engineering fall toward the middle of the distribution, indicating that there is moderate stability in the major field choices made by these students. The second column, showing percentages of students interested in graduate study in business shows some very interesting patterns. As noted before, 90 percent of undergraduate business majors plan to major in business at the graduate level as well. Students in education and the biological sciences, in contrast, have almost no interest in this field at the graduate level (3 and 4 percent, respectively). What is interesting, however, are the fields such as

Table 7.12
Percentage of Undergraduate Majors Planning Graduate Study in Same Field or in Business

	Percentage planning graduate study in same field as undergraduate major	Percentage planning graduate study in business
Architecture	75	11
Arts	62	9
Biological sciences	65	4
Business	90	90
Education	78	3
Engineering	59	29
Health professions	72	13
Humanities	53	14
Nursing	82	10
Physical sciences	55	15
Psychology	57	11
Social sciences	38	38

Note: Tabulations based on FUSALL sample.

engineering and the social sciences where hefty percentages of students plan postgraduate work in business: Nearly one–third of the engineering students are planning graduate work in business! This tendency is also strong for students in the social sciences, where equal numbers plan future study in the social sciences and business.

The question of sources of graduate students in the sciences is addressed by the data in Table 7.13. These data show that three fourths of graduate students in biological and physical science fields come initially from these same fields, and that four-fifths of engineering graduate students come from engineering. Indeed when we consider all undergraduate SME fields together, more than 80 percent of graduate students in the natural sciences and more than 90 percent of the graduate students in engineering come from undergraduate SME fields. These figures reinforce the notion that science is pretty much a "one-way" street. The lack of diversity in terms of the rate at

Table 7.13
Major Field Sources of Graduate Students in Science-related Fields

	Percent of those planning graduate study in science-related fields from different majors fields			
Undergraduate Major Field	Biological Sciences	Physical Sciences	Engineering	Medicine[1]
Architecture	0	0	0	0
Arts	1	0	0	1
Biological sciences	72	2	0	44
Business	0	3	1	0
Education	1	3	0	4
Engineering	2	7	82	2
Health professions	1	0	0	21
Humanities	4	1	1	4
Nursing	0	0	0	0
Other	6	5	6	8
Physical sciences	8	76	9	5
Psychology	3	0	0	8
Social sciences	2	3	1	4

Note: Tabulations based on FUSALL sample. Percentages total in the column.
[1] MD, DO, DDS, and DVM.

which students switch fields is also an indication of the strong disciplinary boundaries found in most SME fields. These boundaries occur not only between specific SME categories (physical science, biological science, etc) but also between SME and nonscience fields. Medicine, as an applied science field, attracts the most students from outside of science (although the lion's share still comes from the fields most directly related to medicine: biological sciences and the health professions).

Summary

Students' degree aspirations are an important aspect of undergraduate science education, given that the post-baccalaureate training is essential for many science-related careers. In this chapter we have examined how students' aspirations for advanced training changed during the undergraduate years and attempted to identify various personal and environmental factors associated with these changes.

The students in our sample entered college with very high aspirations and generally maintained or even increased these aspirations during the undergraduate years. Substantial increases in student interest in all post-baccalaureate degrees were observed, except for medical degrees, where there was a very large decrease. These changes vary, however, by field of study. Controlling for initial (freshman) degree aspirations, we find that during college, students initially majoring in the biological sciences gravitate toward the MD degree, that physical science students gravitate toward the PhD, and that engineering students gravitate toward Master's degrees (most commonly the MBA). To a large extent these changes may simply reflect students' increasing understanding of which degree is most appropriate for which field.

Longitudinal multivariate analyses show only a modest correlation between initial and follow-up degree plans, reflecting the substantial switching that occurs during the undergraduate years. Entering freshmen characteristics that are most strongly associated with increases in degree aspirations include intellectual self-esteem, SAT verbal score, and an initial intention to attend college in order to prepare for graduate or professional school.

Environmental experiences most closely associated with aspirations for advanced degrees include living on campus during the undergraduate years, academic performance in college, frequent interaction with faculty, and attending an institution with a very strong emphasis on the humanities. In short, these findings reinforce the idea that students' aspirations for advanced degrees are influenced both by the peer environment and by the faculty. Somewhat ironically, large universities–the very institutions that produce the bulk of the advanced degrees in the sciences–appear to have a negative impact on undergraduate students' aspirations for advanced degrees.

The graduate fields of study chosen by the students at the time of the follow-up survey reflect once again the "one-way" street that characterizes changes in the undergraduate student's interest in postgraduate study in science. That is, only small numbers of students (between 5 and 15 percent, depending on the science-related field) are recruited into postgraduate study in the sciences from nonscience fields. That there is also relatively little switching among different SME fields between the undergraduate and graduate years, suggests the presence of rather strong disciplinary boundaries separating various SME subfields.

CHAPTER 8

How Undergraduates Experience Science Education

The preceding chapters have examined factors influencing students' choices of science-related majors and careers, their acquisition of scientific knowledge and quantitative skills, and their academic success in college and entry to graduate school. In this chapter we focus on the undergraduate's experience with science courses, faculty, and facilities. We shall also examine factors influencing their interest in contributing to scientific theory and knowledge. By way of introduction to the empirical analyses relating to these topics, we begin with a brief review and discussion of some relevant literature.

Background

College students planning careers in science need to see and learn from professors who are excellent research role models. Instead, they read about increasing reported instances of scientific fraud. More to the point, they rarely are taught by instructors who are actively engaged in research and can model this process for them.

Many undergraduates at large universities are taught by teaching assistants. About half the graduate students in many science and engineering disciplines are international students and the fact is that many of them do not have a full command of English. According to an article in the National Academy of Sciences Journal, "The majority of these foreign born engineering students come from countries where the language and culture are likely to be significantly different from those of most native born U.S. citizens" (Penner, 1988, p.78).

Another reason for the lack of good role models has to do with the stark contrast between the distribution of federal funds and the distribution of talented academic scientists. In his book, Strengthening Academic Science, Drew (1985) discusses how this disparity threatens the productivity of a generation of young researchers. For many years, federal funds for university research have been concentrated in a few institutions. Roughly half the federal support for basic research in many disciplines is awarded to the top 20 universities every year. But Drew's data suggest that the top young researchers may not be at the top 20 institutions. Because of the demography of the academic world over the past 15 years—in particular the "tenure log jam" in which many leading institutions have virtually no job openings—the most talented new Ph.D.s from the best departments who choose academic careers often take jobs in the second and third tier institutions. Thus, most of the best young physicists from Harvard, Berkeley, and Michigan are not taking jobs at similar institutions; rather, they gravitate toward schools like the University of Arkansas and North Dakota State University.

Drew reports analyses from surveys of 60,000 scientists and hundreds of interviews with scientists and administrators. The data reveal that the continued concentration of federal science funds may be destroying the potential productivity of brilliant young scientists at second and third tier universities. Furthermore, these new PhDs then are unable to demonstrate to undergraduates what the research process looks like. And, of course, they are unable to engage undergraduates directly as participants in that research process. College students who hear young professors talk about the excitement of research, but note that these same professors are not conducting much research, are probably less likely to choose careers as scientists.

This situation is made more serious by the fact that there are vast numbers of students, many of them highly capable potential scientists, enrolled at these universities. While some of the recent literature about future scientists focuses on the Ivy League and other elite research universities and some discusses the Antioch, Pomona, or other selective liberal arts colleges, the fact of the matter is that there are far more students enrolled in the large state universities. Thousands more of our young people are attending schools like Montana State, Kansas State, and the University of Missouri rather than schools like Harvard, Stanford, and Oberlin.

Role models and mentors are just as important for elementary and secondary school students. Senator John Glenn recently gave a vivid description of how his interest in science was stimulated by a high school teacher who invited Glenn to join him and his family on a summer vacation trip.

Senator Glenn described with great enthusiasm how he saw steel being made in Pittsburgh and how they visited Niagara Falls where he watched the generators in awe.

Attitudes Toward Mathematics

Research is revealing that mastery of math is one of the most important factors relating to an individual's success in college and beyond (see also Chapters 6 and 7). Furthermore, virtually everyone can learn advanced mathematical concepts, even those who start late. Negative attitudes about math achievement are based on incorrect assumptions about who can learn this subject.

The avoidance of math may well be the hidden factor that explains a surprising percentage of the career decisions made by young people (see especially Chapters 4 and 5). There are people who want to be doctors and dentists but who choose other careers so they won't have to take math in college. One of our site visitors overheard an academic counselor at a large technical university who works with community college transfers report that she repeatedly is told "I'd like to major in ___, but I can't do math so I'm going to become a teacher instead."

A recent College Board study about success in the SATs and college concluded that the key factor is mathematics. In fact, Donald Stewart, president of the College Board, says that "Math is the gatekeeper for success in college."

Achievement, Self-Concept and Aspirations

Even when our educational system works for Anglo, middle-class, male children, it sometimes discourages females and minorities from careers in science, mathematics, and engineering. As noted above, in recent years more than half of the PhDs in engineering nationally were awarded to foreign students. The percentages awarded to women, blacks, and Hispanics were dismally low. The silver lining around this particular cloud is that these previously neglected students represent a large source of very capable future scientists.

Contributing to the problem are the attitudes and expectations held by some teachers about the capabilities of girls and minority students. One of our project staff teaches about multivariate statistical analysis in the PhD program at The Claremont Graduate school. He has encountered statistical analysis in the PhD program at The Claremont Graduate school. He has encountered many students, especially women and minority students, who feared math and were sure they could not do it. Virtually all of these students then discover they are capable of understanding and conducting sophisticated statistical analyses like hierarchical multiple regression. Their negative self-image often derives from an elementary school teacher with a sexist or racist attitude, a person who thought, "Girls can't do math," and managed to traumatize a student who now must be convinced about her real ability. Sheila Tobias (1978) has studied "math anxiety" and has shown how and why this affliction is particularly prevalent among women.

Many people have become aware of the extraordinary accomplishments of Jaime Escalante. This mathematics teacher at Garfield High School in East Los Angeles successfully prepared many Latino and other minority students from poor families to take the Educational Testing Service Advanced Placement test in calculus. The movie "Stand and Deliver" told this story well. But, the most important message from this experience is not that Jaime Escalante is an extraordinary and successful teacher, although this is certainly true. The message is that many poor, minority high school students, who otherwise might have been considered incapable of mastering calculus, did just that when they were taught by such a creative instructor.

Many teachers erroneously believe that certain kinds of students can't do math. Students, in turn, often incorporate those devastating myths into their self concept and then lower their aspirations, thereby short-changing what they can do with their lives.

Cooperative Learning

Some of the most exciting research about how people learn math was carried out by Uri Triesman, when he was a graduate student at Berkeley. While a teaching assistant in calculus courses, Triesman observed that the African-American students performed very poorly while the Chinese students excelled. He did not accept the conventional wisdom that the low achievement rates of African Americans students was due to such factors as their parent's poverty or the poor schools they attended as young children. He thought that it had to do with how they studied, what

Chinese and African-American students. He found that the Chinese spent longer hours studying than other students and that they frequently studied together in groups, even creating extra homework problems to solve as a group. Triesman then developed an experimental workshop in which he replicated these interaction and study patterns with the African-American students. The results were astounding. The African-American students went on to excel in calculus.

Triesman found that, in comparison to students who entered college with a given SAT performance level, his workshop minority students consistently out-performed both Anglos and Asians. A central component of the workshop approach was to stretch the students to excel by giving them extra, *advanced* problems. Many of these minority students had been experiencing difficulties and failure in the pre-workshop era, in part because they were high school Valedictorians who resented and rejected an approach based on remediation. In short, one key to Triesman's success was his focus on self-concept. Triesman treats them like the winners they can be, not like helpless losers.

A critic might note that those African-American students already were good enough to be admitted to Berkeley. Would these methods work in other colleges and universities and would they work with students of other ethnic backgrounds? Martin Bonsangue, in collaboration with one of our project staff, David Drew, are currently utilizing a grant from the National Science Foundation to explore these questions. Bonsangue has completed analyses of data he gathered about a workshop program based on the Triesman model that has been implemented at Cal-Poly Pomona. This institution has the oldest and best established workshop program in the country. The preliminary results show precisely the kind of dramatic improvement from the Cal-Poly workshops that Triesman found at Berkeley. This evaluation revealed that the effects are not limited to one ethnic group; the calculus achievement of Latino workshop students improved dramatically. Furthermore, the effects persisted through the college years. For example, workshop participants are much less likely to drop out of SME majors (Bonsangue & Drew, 1992).

Peer Group Effects

James Davis (1966) began a theoretical exchange in his now classic "frog pond" article, in which he applied the theory of relative deprivation, first elaborated by Samuel Stouffer in his studies of the American soldier (Stouffer and others, 1949), in a special analysis of the aspirations of college seniors based on data from the National Opinion Research Center (NORC). Essentially, relative deprivation theory asserts that people increase their self-esteem and aspirations if they are "big frogs in a little pond." Thus, Davis argued that undergraduate career choice is a function of "academic self-concept," which, in turn, is based in part on the student's assessment of his/her performance relative to that of other students in the same school. To support this hypothesis, he reported data showing that the graduating senior's career choice is more highly related to his college grade point average (a local measure of performance) than his school's quality or reputation (a measure which reflects the national distribution) when initial freshman career choice and aptitude are controlled. Unfortunately, Davis was forced to work with rather limited measures of both school quality and scholastic aptitude.

A different school of thought is represented by the environmental press theorists, who argue that students' achievement and aspirations are a function of the social context. Basically this theory differs from relative deprivation theory in the role that it assigns to college quality or selectivity. According to the relative deprivation theory, selectivity should have a negative effect on aspirations because it has a negative effect on academic achievement (that is, a given student will have a harder time getting good grades at a highly selective college). Environmental press theory maintains that selectivity should positively affect aspirations, since an undergraduate will perform best and aim highest at a school where most fellow students have high aspirations and are superior academically. Werts and Watley (1969), using a multiple regression model with a national sample of undergraduates to test the relative predictive power of the two theories, reported findings which tended to support relative deprivation theory; but they, too, lamented their crucial missing link —a measure of academic self-concept.

Drew and Astin (1972) tested these theories with the CIRP longitudinal data base. A basic assumption underlying their work was that these middle-range theories belong in a conceptual framework within the context of reference group theory. Reference group theory, of course, has been invoked to explain undergraduate phenomena beyond that of career aspirations (Drew, 1969). In addition, it has been shown that what appear to be college effects can vanish when the input characteristics of the student body are controlled (Astin, 1968). A complete analysis of student body reference group impact requires that all possible control variables be considered. Drew and Astin controlled simultaneously a rather lengthy list of variables. In addition, they had available, through their use of the CIRP data base, several critical variables that had been missing in previous analyses. Their results showed that the two theories (relative deprivation and environmental press) were both valid, since each had an effect on specific kinds of educational aspirations, and that previous investigators who had forced a choice between the two theories had been creating a straw man.

Drew and Patterson (1973) repeated the tests of these theories with the CIRP data base, carrying out the analyses separately for men and women. Their results indicated that relative deprivation was more pronounced for the men than for the women. That is, women needed a stronger absolute indicator of their ability, for example, faculty praise for an outstanding project, before they were sufficiently motivated to increase their aspirations (particularly in the mid 1960s, when the data were collected). These results were consistent with other research (Horner, 1971) on the development of career goals and educational aspirations among women.

Alexander and Eckland (1975) differentiated two dimensions of the student body, ability and social status, and found that each affected the student's educational attainments differently. The "college environment" is not a single entity; its components and effects must be analyzed carefully. Basis (1977) argued that reference group effects can be isolated more effectively using multiple linear path analysis models.

Methods

The dependent variables examined in this chapter are:

- Student satisfaction with science and math faculty, curriculum, and resources.
- Career activity goals, especially making a theoretical contribution to science

The key intervening ("involvement" or "intermediate outcome") variables, each of which can be considered as an important outcome in its own right, are:

- Self-rating of mathematical ability
- Worked on a professor's research project
- Assisted faculty in teaching a course
- Worked on an independent research project

For most of the analyses reported below, a subsample of respondents was used consisting of those students who were still in college at the time the 1989 follow up survey was done. This group consisted of 12,197 students. Of these, 2,697 were science majors, defined as those who are in either the biological sciences, the physical sciences, or engineering (1,513 men and 1,184 women).

Responses to each of the key variables will be presented separately for: science and non-science majors, men and women, and ethnic groups. As noted above, a major concern in the science policy literature is the continuing underrepresentation of women and minorities in SME. This study examined attitudinal factors that may affect the career development of women and minority students.

Individual pre-college attributes (inputs) that affect the dependent variables were identified. More to the point, however, was the identification of environmental factors in the college experience that affect students' college experiences and shape the development of their attitudes about science from the freshman to the senior years. As discussed above, considerable research has demonstrated the effect of reference groups, e.g., faculty, family, and peers upon undergraduates (see, for example, Drew, 1969; Drew & Astin, 1972; Astin, 1968; Bowen, 1968; and Dey, 1990).

Results

Satisfaction

In this section we shall first present descriptive statistics for satisfaction, goals, experiences, and self concept, and then present the results of regression analyses using these variables as outcome measures.

Frequency distributions for each of nine variables measuring satisfaction with the college experience are presented in Tables 8.1 through 8.9. In each table the frequency distribution for the variables is presented separately for each of 16 subgroups. The subgroups are defined by gender, ethnicity (Anglo, African American, Latino, and Asian American), and whether the student was a science major or not. It is recognized that both "Latino" and "Asian American" are broad categories. For example, the category Asian American used here and elsewhere by researchers, would encompass students of Japanese, Chinese, Korean, Thai, and other backgrounds. Each of those cultures is distinctly different and each presumably would have a different effect on the values, orientation, and aspirations of college students. Unfortunately, even with the large sample, there still are not enough students from each of these subgroups to justify statistically disaggregating the analysis at that fine a level. In preliminary analyses we disaggregated and analyzed separately Puerto Rican students, but the numbers were so small as to call into question the reliability of estimates based on those subsamples. Consequently, Puerto Rican students were added into the "Latino" category.

These tables about the satisfaction variables contain a considerable amount of data. Nonetheless, a few trends in the data are strong enough to warrant being highlighted. The general level of satisfaction reported for some of the variables, e.g., science and math courses, courses in major field, and contact with faculty/administration, is higher than the percentages reported for the other variables. With the exception of the two variables directly dealing with science, i.e., science and math courses and laboratory facilities, the responses of science majors and nonscience majors are approximately the same. (In the case of those two exceptions, the science majors reported higher levels of satisfaction than the nonscience majors.)

Table 8.1
Frequency Distributions: Satisfaction with Science and Math Courses
Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1267	5.5	6.7	43.2	44.6
		Nonscience	2853	10.6	27.0	46.5	15.9
	Female	Science	877	3.9	6.5	45.5	44.1
		Nonscience	5310	11.9	25.7	47.3	15.0
African-American							
	Male	Science	35	2.9	2.9	40.0	54.3
		Nonscience	114	12.3	26.3	43.9	17.5
	Female	Science	79	10.1	5.1	41.8	43.0
		Nonscience	313	12.8	25.2	50.5	11.5
Latino							
	Male	Science	17	11.8	11.8	41.2	35.3
		Nonscience	47	14.9	23.4	38.3	23.4
	Female	Science	16	18.8	6.3	31.3	43.8
		Nonscience	83	13.3	19.3	53.0	14.5
Asian-American							
	Male	Science	106	2.8	10.4	55.7	31.1
		Nonscience	80	12.5	25.0	42.5	20.0
	Female	Science	72	9.7	2.8	55.6	31.9
		Nonscience	158	11.4	25.9	48.7	13.9

Table 8.2
Frequency Distributions: Satisfaction with Courses in Major Field
(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1263	4.7	7.8	38.3	49.2
		Nonscience	2955	6.3	7.5	39.1	47.1
	Female	Science	872	4.5	5.0	39.6	50.9
		Nonscience	5539	6.6	5.1	36.3	52.0
African-American							
	Male	Science	36	5.6	13.9	33.3	47.2
		Nonscience	115	6.1	6.1	35.7	52.2
	Female	Science	78	11.5	5.1	43.6	39.7
		Nonscience	308	10.1	5.5	38.0	46.4
Latino							
	Male	Science	17	11.8	0.0	41.2	47.1
		Nonscience	49	2.0	10.2	34.7	53.1
	Female	Science	16	18.8	12.5	18.0	50.0
		Nonscience	87	2.3	5.7	39.1	52.9
Asian-American							
	Male	Science	104	5.8	9.6	50.0	34.6
		Nonscience	81	2.5	8.6	46.9	42.0
	Female	Science	72	11.1	5.6	40.3	43.1
		Nonscience	165	10.3	7.3	48.5	33.9

Table 8.3
Frequency Distributions: Satisfaction with Overall Quality of Instruction
(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1268	5.3	12.9	53.8	28.1
		Nonscience	3018	4.4	13.5	52.6	29.5
	Female	Science	881	3.2	11.7	54.3	30.9
		Nonscience	5655	4.2	10.3	53.7	31.8
African-American							
	Male	Science	36	5.6	19.4	47.2	27.8
		Nonscience	119	4.2	20.2	47.9	27.7
	Female	Science	79	5.1	11.4	59.5	24.1
		Nonscience	324	4.3	16.4	54.9	24.4
Latino							
	Male	Science	17	0.0	11.8	58.8	29.4
		Nonscience	50	2.0	18.0	34.0	46.0
	Female	Science	16	18.8	12.5	50.0	18.8
		Nonscience	89	4.5	7.9	46.1	41.6
Asian-American							
	Male	Science	106	9.4	14.2	54.7	21.7
		Nonscience	82	4.9	8.5	67.1	19.5
	Female	Science	72	4.2	15.3	62.5	18.1
		Nonscience	167	4.2	11.4	56.3	28.1

Table 8.4
Frequency Distributions: Satisfaction with Lab Facilities and Equipment
(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1239	13.4	16.8	43.3	26.5
		Nonscience	2365	11.0	29.7	43.2	16.1
	Female	Science	854	12.1	13.8	47.8	26.3
		Nonscience	4394	8.5	26.9	47.6	16.9
African-American							
	Male	Science	36	22.2	13.9	38.9	25.0
		Nonscience	106	19.8	27.4	34.9	17.9
	Female	Science	78	26.9	15.4	38.5	19.2
		Nonscience	278	15.8	26.3	46.4	11.5
Latino							
	Male	Science	17	0.0	11.8	52.9	35.3
		Nonscience	41	9.8	34.1	31.7	24.4
	Female	Science	16	43.8	18.8	31.3	6.3
		Nonscience	70	7.1	30.0	47.1	15.7
Asian-American							
	Male	Science	105	6.7	22.9	51.4	19.0
		Nonscience	68	7.4	26.5	52.9	13.2
	Female	Science	70	8.6	17.1	60.0	14.3
		Nonscience	131	7.6	22.9	52.7	16.8

Table 8.5
Frequency Distributions: Satisfaction with Library Facilities
(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1263	14.2	13.1	40.5	32.2
		Nonscience	3007	18.1	13.7	39.9	28.3
	Female	Science	879	19.9	14.8	38.0	27.3
		Nonscience	5644	19.5	13.4	41.0	26.1
African-American							
	Male	Science	36	16.7	27.8	33.3	22.2
		Nonscience	118	20.3	16.1	35.6	28.0
	Female	Science	79	49.4	8.9	25.3	16.5
		nonscience	323	33.1	14.9	35.0	17.0
Latino							
	Male	Science	17	17.6	11.8	41.2	29.4
		Nonscience	50	10.0	16.0	32.0	42.0
	Female	Science	16	25.0	18.8	31.3	25.0
		Nonscience	89	23.6	7.9	44.9	23.6
Asian-American							
	Male	Science	105	13.3	13.3	50.5	22.9
		Nonscience	83	14.5	12.0	44.6	28.9
	Female	Science	72	16.7	8.3	47.2	27.8
		Nonscience	166	14.5	13.3	45.8	26.5

Table 8.6
Frequency Distributions: Satisfaction with Computer Facilities
(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1230	9.5	16.4	38.7	35.4
		Nonscience	2807	13.6	17.1	41.5	27.8
	Female	Science	831	11.1	16.0	44.0	28.9
		Nonscience	5079	13.1	16.9	45.7	24.3
African-American							
	Male	Science	35	17.1	20.0	37.1	25.7
		Nonscience	112	10.7	19.6	42.0	27.7
	female	Science	75	8.0	13.3	46.7	32.0
		Nonscience	306	13.1	15.0	46.1	25.8
Latino							
	Male	Science	17	29.4	17.6	11.8	41.2
		Nonscience	48	8.3	22.9	29.2	39.6
	Female	Science	13	7.7	15.4	46.2	30.8
		Nonscience	78	12.8	14.1	41.0	32.1
Asian-American							
	Male	Science	102	7.8	17.6	33.3	41.2
		Nonscience	75	9.3	14.7	45.3	30.7
	Female	Science	69	5.8	15.9	46.4	31.9
		Nonscience	149	7.4	14.1	48.3	30.2

Table 8.7

Frequency Distributions: Satisfaction with Opportunity to Talk to Professors

(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1256	6.7	11.6	37.5	44.2
		Nonscience	2985	5.2	11.2	35.4	48.1
	Female	Science	871	4.4	8.4	32.5	54.8
		Nonscience	5617	4.3	9.6	36.3	49.7
African-American							
	Male	Science	36	5.6	16.7	41.7	36.1
		Nonscience	119	5.0	10.1	45.4	39.5
	Female	Science	79	3.8	13.9	35.4	46.8
		Nonscience	323	4.6	7.4	45.8	42.1
Latino							
	Male	Science	17	11.8	0.0	47.1	41.2
		Nonscience	49	6.1	12.2	42.9	38.8
	Female	Science	16	18.8	12.5	12.5	56.3
		Nonscience	88	8.0	8.0	43.2	40.9
Asian-American							
	Male	Science	104	17.3	26.0	35.6	21.2
		Nonscience	83	10.8	20.5	38.6	30.1
	Female	Science	70	10.0	20.0	30.0	40.0
		Nonscience	163	6.1	14.7	41.7	37.4

Table 8.8

Frequency Distributions: Satisfaction with Contact with Faculty/Administration

(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1253	8.5	22.3	42.0	27.3
		Nonscience	2977	7.6	18.9	41.9	31.7
	Female	Science	873	7.0	16.0	41.1	35.9
		Nonscience	5572	7.4	18.3	42.7	31.6
African-American							
	Male	Science	36	16.7	25.0	47.2	11.1
		Nonscience	118	7.6	28.0	40.7	23.7
	Female	Science	78	12.8	14.1	50.0	23.1
		Nonscience	325	8.9	21.2	47.4	22.5
Latino							
	Male	Science	17	5.9	23.5	52.9	17.6
		Nonscience	48	6.3	22.9	37.5	33.3
	Female	Science	16	18.8	25.0	25.0	31.3
		Nonscience	89	11.2	15.7	48.3	24.7
Asian-American							
	Male	Science	105	17.1	36.2	32.4	14.3
		Nonscience	81	17.3	27.2	39.5	16.0
	Female	Science	70	18.6	31.4	32.9	17.1
		Nonscience	161	9.3	24.2	42.9	23.6

Table 8.9
Frequency Distributions: Satisfaction with Relations with Faculty/Administration
(Percentages)

Subgroup			N	Dissatisfied	Neutral	Satisfied	Very Satisfied
Anglo							
	Male	Science major	1252	7.6	22.8	44.3	25.2
		Nonscience	2981	7.3	18.3	44.0	30.4
	Female	Science	869	6.2	17.1	43.0	33.6
		Nonscience	5568	6.1	18.0	44.7	31.2
African-American							
	Male	Science	36	13.9	25.0	41.7	19.4
		Nonscience	119	7.6	29.4	46.2	16.8
	Female	Science	79	19.0	12.7	43.0	25.3
		Nonscience	321	12.8	18.4	44.9	24.0
Latino							
	Male	Science	17	5.9	29.4	58.8	5.9
		Nonscience	50	6.0	18.0	42.0	34.0
	Female	Science	16	18.8	18.8	37.5	25.0
		Nonscience	88	9.1	18.2	50.0	22.7
Asian-American							
	Male	Science	105	13.3	40.0	38.1	8.6
		Nonscience	81	12.3	30.9	39.5	17.3
	Female	Science	69	13.0	34.8	36.2	15.9
		Nonscience	162	8.0	24.7	41.4	25.9

These differences in satisfaction with science and math courses between science majors and nonscience majors may be important (Table 8.1). Note that these two groups report roughly equivalent levels of satisfaction with course work in their own fields (Table 8.2). It's not the case that nonscience majors are inherently more dissatisfied with course work than science majors. The low levels of satisfaction with science and math courses on the part of nonscience majors may relate directly to issues addressed by Sheila Tobias in They're Not Dumb, They're Different. Tobias hired highly literate people who successfully had studied the humanities to take introductory science courses and to keep journals about their experiences. In other words, these were intelligent, articulate people, all post-graduates in the humanities, who had not been drawn into science for one reason or another. Their journals revealed numerous problems in the way introductory science courses are presented, problems that deter many people from further study in science. For example, one student complained that the professor rushed from topic to topic, devoting little or no time to integrating the material with the knowledge base the students brought to the classroom. Discussion and interpretation were down-played or omitted.

Factors like those uncovered by Tobias may explain the discrepancies in satisfaction levels reported in Table 8.1. For example, among Anglos (the largest single ethnic subgroup) the percentages of science majors who report that they are neutral or dissatisfied with science and math courses are 12.2 (males) and 10.4 (females). By contrast, the percentages of Anglo nonscience majors who report that they are neutral or dissatisfied are 37.6 (males) and 37.6 (females). Examination of the data for Asian Americans (the ethnic subgroup yielding the second highest number of science majors) reveals that the comparable percentages of science majors who were neutral or dissatisfied with their science and math courses are 13.2 (males) and 12.5 (females). For nonscience majors these percentages jumped to 37.5 (males) and 37.3 (females). The same trend can be observed in the percentages reported for African-American and Latino students.

For the first three variables (Tables 8.1, 8.2, and 8.3), which deal with courses and instruction, men and women report roughly equivalent levels of satisfaction. With some exceptions, men report higher levels of satisfaction than women with the next three variables (Tables 8.4, 8.5, and 8.6), which deal with facilities and resources. Men report higher levels of satisfaction with laboratory facilities, and with library facilities (except among Asians). Among scientists, males report higher levels of satisfaction with computer facilities than women (except among Blacks). With some exceptions, women consistently report higher levels of satisfaction than men on the variables having to do with student-faculty interaction. Specifically, women score higher on satisfaction with opportunity to talk to professors (Table 8.7), satisfaction with contact with faculty/administration (Table 8.8) (although this is true among science majors only), and satisfaction with relations with faculty/administration (Table 8.9) (except among Latino nonscientists where males score higher).

Satisfaction with overall quality of instruction (Table 8.3) is an important outcome. There are a few striking differences between subgroups on this variable. It should be noted that among African-Americans, males are somewhat more likely to say that they are very satisfied with instruction than females. Among Latinos, nonscience majors are more likely to report being very satisfied with the quality of instruction than science majors. However, some of these differences may relate to the very subtle distinction between "very satisfied" and "satisfied."

Within each ethnic group females express somewhat higher levels of dissatisfaction with library facilities (Table 8.5). In comparing the ethnic subgroups, it is clear that the African-American students tend to be less satisfied with library facilities than the other three subgroups for whom data are reported in these tables. Also, there is a small trend in which female students tend to report more dissatisfaction with library facilities than male students.

The data in Table 8.7 concern satisfaction with the opportunity to talk with professors. It is clear that Asian-Americans are considerably more dissatisfied than students from other ethnic subgroups. There are no striking differences reported in this table between science majors and nonscience majors. Women tend to report higher levels of satisfaction than men with their opportunity to talk to professors.

Similarly, the data in Table 8.8 reveal that Asian-Americans are most likely to be dissatisfied with their contact with faculty and administration. The ethnic subgroup reporting the highest level of satisfaction with respect to this outcome is Anglos. The data reported in Table 8.9 indicate that Anglos have the highest level of satisfaction with relations with faculty and administration. Women tend to be somewhat more likely than the men to indicate that they were very satisfied with relations with the faculty and administration.

In summary, there are few trends in these satisfaction variables relating to ethnicity. Anglos tend to report higher levels of satisfaction with: science and math courses (African Americans also report high levels), library resources, opportunities for contact with faculty/administration and relations with faculty/administration. Asian-Americans report less satisfaction with opportunity to talk to professors and with coursework in their majors.

The follow-up survey contained 27 items assessing student satisfaction with various undergraduate programs. The nine variables reported above in Table 8.1 through 8.9 were selected as the satisfaction items that related, directly or indirectly, to science, mathematics and engineering.

Since satisfaction is the primary focus of this section of the report, a principal components factor analysis, and Varimax rotation, were conducted with these items to explore further their structural characteristics. The sample contained science majors only. Table 8.10 presents the rotated factor matrix and the associated eigenvalues. It is clear that factor 1 deals with students' interaction with professors and the administration; factor 2 assesses their reaction to courses, curriculum and instruction; and factor 3 focuses on equipment, facilities and resources. Building upon these results, three new composite variables were created. In each case, the three variables with high factor loadings on each factor simply were added together with unit weights. Thus, the composite variable related to factor 1 was created by adding scores for opportunity to talk to professors, contact with faculty/administration, and relations with faculty/administration.

The three composite variables then were subjected to reliability tests. The Cronbach Alphas achieved by each of the the variables were: composite variable 1 (Alpha = .87); composite variable 2 (Alpha = .74); and composite variable 3 (Alpha = .63).

In an earlier study, Milem (1991) conducted a factor analysis (using the principal access factoring method) of all 27 items in the follow up survey that assessed student satisfaction. (Milem

Table 8.10
Rotated Factor Matrix

Satisfaction with:	Factor 1	Factor 2	Factor 3
science and math courses	.16	.83	.09
courses in major field	.15	.84	.08
overall quality of instruction	.47	.56	.24
lab facilities and equipment	.10	.34	.65
library facilities	-.03	-.01	.80
computer facilities	.08	.06	.78
opportunity to talk to professors	.80	.23	.01
contact with faculty/administration	.92	.13	.04
relations with faculty/administration	.89	.14	.07
Eigenvalue	3.48	1.64	1.08
Percent of variance	38.70	18.30	12.00

N= 2312

employed a method which calculated initial communality estimates from the squared multiple correlations while the current analysis used a method which set the communalities equal to unity.) Following Varimax rotation, Milem identified a five factor model. One of his factors, about faculty contact, was identical with the factor about faculty contact in this study. Milem's factor 4, academic facilities, included five variables initially; however, when he calculated the final factor, only three variables were included and it was identical with the academic facilities factor in this study. Thus, two of the three factors identified by focussing on the nine science-related variables were identical with those identified in Milem's study of the full range of 27 satisfaction items. The third factor in this study, about courses, curriculum and instruction, does not directly parallel Milem's findings.

Goals, Experiences, and Self-Concepts

Tables 8.11 through 8.15 present frequency distributions for three career activity goals ("making a theoretical contribution to science", "becoming an authority in my field", and "obtaining recognition from my colleagues for contributions to my special field"), three research and teaching experiences ("worked on professor's research project", "assisted faculty in teaching a course", "worked on an independent research project"), and mathematical ability self-concept.

For the most part, in each of these tables male students achieve higher percentages in science related activities or aspirations than female students and science majors certainly exhibit higher percentages than nonscience majors. But there are some surprises. For one thing, minority students tend to report percentages comparable to those of majority, or Anglo, students. Also, the proportion of female science majors who report working on a professor's research project is higher than the proportion of male science majors, within each ethnic group. Although the sample sizes are quite small, it should be noted that Latino women score higher than Latino men on each of the career activity goal measures.

While there are no surprising trends in the data reported for the goal of making a theoretical contribution to science (Table 8.11), an interesting difference emerges from Table 8.12 about the goal of becoming the authority in one's field. Among science majors, males are more likely to list this as an essential goal than females in each ethnic group. An exception is the Latinos where females are more likely to list this as an essential goal; however, as indicated earlier, the data on Latino science students should be read with caution, since the sample sizes are so low. Also, within all ethnic subgroups, except Asian-Americans, male nonscience students are more likely to list this an as essential goal than female nonscience students.

Table 8.13 presents data on the goal of "obtaining recognition from my colleagues for contributions to my special field" and includes an interesting finding that, undoubtedly, relates to cultural norms. Among science majors, Asian-American males are considerably more likely than Asian-American females to list this as an essential goal. With the exception of Latinos, there is a more general trend in which males (both science and nonscience majors) list this as an essential goal somewhat more frequently than females.

Examination of Table 8.14 reveals that Asian-American women were much more likely than Asian-American men to have worked on a professor's research project and to have assisted faculty in a course (both science and nonscience majors). Clearly, science majors are more likely than nonscience majors to have worked on a professor's research project and to have assisted faculty in teaching a course. Asian-Americans were somewhat less likely than students from other ethnic groups to have worked on an independent research project. This was true of both science and nonscience majors. Among science majors, males were somewhat more likely to have worked on an independent research project.

Given the central importance of self-concept in the development of educational aspirations and career choice, Table 8.15 is particularly instructive. The most dramatic differences are found between male and female follow-up self-concepts. The percent of Anglo male science majors who see themselves as being in the "highest two percent" is 44.1 while the corresponding percent for Anglo female science majors is 29.4. The percentages of science majors who report that they are in the top ten percent for each of the other three ethnic groups are as follows: African-American

Table 8.11

Frequency Distributions: Goal is Making a Theoretical Contribution to Science

(Percentages)

Subgroup			N	Not Important	Somewhat Important	Very Important	Essential
Anglo							
	Male	Science major	1267	26.5	37.2	25.3	11.0
		Nonscience	3014	72.0	19.9	6.2	1.9
	Female	Science	881	31.6	35.2	22.9	10.3
		Nonscience	5654	75.3	18.5	4.8	1.3
African-American							
	Male	Science	36	33.3	27.8	25.0	13.9
		Nonscience	118	52.5	35.6	7.6	4.2
	Female	Science	79	24.1	34.2	30.4	11.4
		Nonscience	325	61.5	25.5	8.9	4.0
Latino							
	Male	Science	17	17.6	64.7	5.9	11.8
		Nonscience	50	64.0	20.0	8.0	8.0
	Female	Science	16	12.5	37.5	31.3	18.8
		Nonscience	89	60.7	28.1	9.0	2.2
Asian-American							
	Male	Science	105	27.6	37.1	22.9	12.4
		Nonscience	83	55.4	30.1	13.3	1.2
	Female	Science	71	26.8	40.8	23.9	8.5
		Nonscience	167	69.5	21.6	6.0	3.0

Table 8.12

Frequency Distributions: Goal is Becoming an Authority in my Field

(Percentages)

Subgroup			N	Not Important	Somewhat Important	Very Important	Essential
Anglo							
	Male	Science major	1268	5.3	27.1	41.6	25.9
		Nonscience	3015	6.5	23.9	43.1	26.4
	Female	Science	881	6.7	30.9	43.1	19.3
		Nonscience	5656	6.2	27.8	42.2	23.7
African-American							
	Male	Science	36	2.8	16.7	41.7	38.9
		Nonscience	118	4.2	11.0	44.9	39.8
	Female	Science	79	3.8	17.7	45.6	32.9
		Nonscience	325	4.3	15.4	45.2	35.1
Latino							
	Male	Science	17	5.9	35.3	41.2	17.6
		Nonscience	50	10.0	18.0	32.0	40.0
	Female	Science	16	0.0	18.8	43.8	37.5
		Nonscience	89	5.6	27.0	42.7	24.7
Asian-American							
	Male	Science	106	4.7	27.4	36.8	31.1
		Nonscience	82	7.3	18.3	47.6	26.8
	Female	Science	71	7.0	36.6	39.4	16.9
		Nonscience	167	9.0	26.3	38.3	26.3

Table 8.13

Frequency Distributions: Goal is Obtaining Recognition from my Colleagues for Contributions to my Special Field (Percentages)

Subgroup		N	Not Important	Somewhat Important	Very Important	Essential
Anglo						
Male	Science major	1267	9.7	38.0	37.6	14.7
	Nonscience	3012	10.8	35.7	37.3	16.3
Female	Science	880	9.1	40.3	37.0	13.5
	Nonscience	5656	10.4	35.7	39.0	14.9
African-American						
Male	Science	36	8.3	33.3	41.7	16.7
	Nonscience	117	4.3	26.5	41.0	28.2
Female	Science	79	6.3	41.8	35.4	16.5
	Nonscience	325	9.5	33.5	40.3	16.6
Latino						
Male	Science	17	11.8	41.2	11.8	35.3
	Nonscience	50	14.0	30.0	32.0	24.0
Female	Science	16	0.0	12.5	43.8	43.8
	Nonscience	88	6.8	29.5	44.3	19.3
Asian-American						
Male	Science	106	5.7	38.7	34.9	20.8
	Nonscience	82	14.6	36.6	36.6	12.2
Female	Science	71	11.3	47.9	31.0	9.9
	Nonscience	168	11.3	33.9	33.9	20.8

Table 8.14

Research and Teaching Experiences (% yes)

		N	Worked on Professor's Research Project	Assisted Faculty in Teaching a Course	Worked on an Independent Research Project
Anglo					
Male	Science major	1271	39.4	25.9	61.6
	Nonscience	3028	17.1	17.1	61.8
Female	Science	883	38.7	28.7	58.6
	Nonscience	5667	19.2	15.3	59.5
African-American					
Male	Science	36	38.9	27.8	61.1
	Nonscience	119	26.1	25.2	70.6
Female	Science	79	40.5	19.0	59.5
	Nonscience	327	24.2	17.4	63.7
Latino					
Male	Science	17	41.2	24.4	64.7
	Nonscience	50	24.0	22.0	48.0
Female	Science	16	43.8	18.8	56.2
	Nonscience	89	23.6	12.4	58.4
Asian-American					
Male	Science	106	41.5	21.7	56.6
	Nonscience	83	16.9	8.4	54.2
Female	Science	72	51.4	20.8	48.6
	Nonscience	168	26.2	18.5	60.7

Table 8.15
Frequency Distributions: Mathematical Ability Self-Concept
(Percentages)

Subgroup		N	Lowest 10%	Below Average	Average	Above Average	Highest 10%
Anglo							
Male	Science major	1269	0.1	2.0	12.2	41.6	44.1
	Nonscience	3018	2.0	13.9	35.2	36.1	12.8
Female	Science	881	0.2	3.3	20.2	46.9	29.4
	Nonscience	5647	3.0	18.9	41.1	31.1	5.9
African-American							
Male	Science	36	0.0	2.8	5.6	63.9	27.8
	Nonscience	118	2.5	14.4	41.5	28.8	12.7
Female	Science	79	0.0	1.3	26.6	50.6	21.5
	Nonscience	326	4.3	19.9	44.2	26.4	5.2
Latino							
Male	Science	17	0.0	0.0	5.9	23.5	70.6
	Nonscience	50	4.0	18.0	26.0	32.0	20.0
Female	Science	16	0.0	25.0	31.3	18.8	25.0
	Nonscience	88	3.4	28.4	36.4	28.4	3.4
Asian-American							
Male	Science	106	0.0	0.9	7.5	49.1	42.5
	Nonscience	82	1.2	14.6	30.5	37.8	15.9
Female	Science	71	0.0	2.8	25.4	42.3	29.6
	Nonscience	167	1.8	9.0	37.7	45.5	6.0

(males 27.8 percent and females 21.5 percent), Latinos (males 70.6 percent and females 25.0 percent) and Asian-American (males 42.5 percent and females 29.6 percent).

These statistics about self-concept are both revealing and disturbing. Nevertheless, a critic might note that even though science majors tend to excel in math, they fail to take into account the actual mathematical ability of the students who are reporting their self-concepts. Consequently, we performed an additional analysis using the student's score on the quantitative portion of the Scholastic Aptitude Test as a measure of mathematical ability. For the full sample, the ninetieth percentile, i.e., the SAT score that defined those students who actually were in the top ten percent, was 670. The ten percent of our longitudinal sample that achieved scores greater than or equal to 670 on the SAT Quantitative subtest included 1,723 people, of whom 1,152 were male and 571 were female. Among the males in this elite group, 53.5 percent considered themselves in the top ten percent and an additional 35.1 percent considered themselves "above average." Among these high aptitude women only 32.6 percent considered themselves in the top ten percent and an additional 51.3 percent considered themselves "above average." One-sixth of the women whose scores placed them in the highest ten percent defined themselves as either average, below average, or in the lowest ten percent!

Further light is shed on this important construct if we relate follow-up mathematical ability self-concept not only to actual ability but also to the self-concept reported by the student as an entering freshman. As can be seen in Table 8.16, among men 734, or 63.7 percent of those men who indeed were in the top ten percent, defined themselves that way when they entered as freshmen. Four years later that percentage had reduced to 53.5 percent. Two hundred and twenty-one of the 734 who initially had accurately placed themselves in the top ten percent reduced their own self-assessment while another 103 students who initially had erroneously placed themselves lower now considered themselves in the highest ten percent.

Among women, 273 out of 571 women, or 47.8 percent, who actually were in the top ten percent defined themselves that way when they entered college. Four years later only 136 (half of the group) of the 273 continue to define themselves as being in the top category; 50 high ability women who initially defined themselves in the lower category as freshmen had increased their assessment during the four year period and now placed themselves appropriately in the highest category. Nevertheless, the proportion of high ability women who actually were in the top ten percent and also perceived themselves as being in the top ten percent dropped from 47.8 percent to 32.6 percent during the college years.

It is important that we and other researchers explore the dimensions of the impact of college upon these students so that we can understand how the self-concepts of both men and women are affected by those experiences. Are these relative deprivation effects? Are declines in self-concept more frequently experienced in certain kinds of college environments?

The effects of the educational system, and other forces in the culture, on the self-concepts of women, including high-ability women, is unsettling.

Table 8.16
Math Ability Self-Concepts of Top Math Students

Males

1985 Self-Concept

1989 Self-Concept	Below top 10%	In top 10%	
Below top 10%	315 75.4%	221 30.1%	536 46.5%
In top 10%	103 24.6%	513 69.9%	616 53.5%
	418 36.3%	734 63.7%	1152

Females

1985 Self-Concept

1989 Self-Concept	Below top 10%	In top 10%	
Below top 10%	248 83.2%	137 50.2%	385 67.4%
In top 10%	50 16.8%	136 49.8%	186 32.6%
	298 52.2%	273 47.8%	571

Regression Analyses

Blocked stepwise regression analyses were conducted to identify individual and institutional factors related to the key dependent variables for the science majors. The outcome measures were the three satisfaction composite variables and the students' commitment to making a theoretical contribution to science. Separate regressions were run for men and women. The potential input variables were assessed sequentially in eight blocks:

1. 1985 pretest of the 1989 outcome measure
2. Demographic and other background characteristics
3. Major and career aspirations
4. Freshman living arrangements and financial aid
5. Curriculum, peer, and faculty measures
6. Institutional characteristics (for example, selectivity)
7. The magnitude of the exposure to the environment, i.e., years enrolled
8. Intermediate outcomes

Tables 8.17 through 8.24 report the findings from these regression analyses. In the case of each outcome variable, separate regressions were run for men and women. The sample for these regressions included only science majors and, of course, only students who were still in school at the time of the follow-up survey. Each table reports the background characteristics and college environment measures that entered the multiple regression equation with a confidence level of at least .001. (The regression coefficient for those variables that were no longer significant when the regression analysis was completed are contained in parentheses.) For each variable, the Beta and the original Pearson correlation with the dependent variable are reported. In addition, the unstandardized regression coefficient, the b, is reported so that, when appropriate, the predictive power of a given variable can be compared for men and women across regressions. Finally, the college experience variables, i.e., the intermediate outcome variables, that subsequently entered the equation are listed along with their regression coefficients. It is important to note that, while the Betas for the college experience variables can be compared with each other to prioritize relative predictive power, these Betas should not be compared directly with those for the background and environment measures which were yielded at a different point in the regression analysis.

Table 8.17
Prediction of Satisfaction Factor 1: Faculty
(Male science majors, N=1431)

Variable	Simple r	b	Beta
Background Characteristics			
Expect to be satisfied with college	.14	.47	.10
Race: White	.17	.68	.09
Felt depressed in high school	-.12	-.46	-.10
Asked teacher for advice in high school	.08	.27	.07
Attending first choice of college	.11	(.12)	(.03)
Outside work	-.07	(-.08)	(-.04)
Typology score: activist	.06	(.03)	(.02)
Career choice: engineering	-.13	(-.04)	(-.01)
College Environments			
Plan to live on campus in fall	.13	(.31)	(.04)
Other college grant	.10	(.17)	(.03)
Aid source: parents or family	-.05	(-.04)	(-.04)
Plan to live off campus in fall	-.13	(-.81)	(-.04)
Faculty have student orientation	.45	.38	.30
Faculty use graduate teaching assistants	-.41	-.58	-.12
(R=.51)			
College Experiences			
Completed at least 4 years	.14	(.26)	(.02)
Talked with faculty outside of class	.33	.51	.19
College GPA	.17	.31	.13
Left school or transferred	-.16	-.80	-.11
discussed course with other students	.13	.33	.07
Received vocational/career counseling	.17	.28	.07
Participated in campus demonstrations	-.01	-.40	-.06
Assisted faculty in teaching	.20	.34	.06
(R= .60)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Considerable information is contained in these regression results. The predictive power (as reflected in the multiple R) is somewhat lower for Factor 2 (courses and instruction) than it is for the other variables. Also, the predictive power (as reflected in the multiple R) with the male samples is higher than that for the females in the case of each of the three satisfaction composite variables. Perhaps the most interesting finding revealed by the regression coefficients is that, for these satisfaction factors, the variables indicating that faculty reported a high orientation toward students (in the separate survey of faculty) consistently has a powerful impact. This variable typically yields a Beta which is substantially higher than the Betas for all the other background and

Table 8.18
Prediction of Satisfaction Factor 1: Faculty
(Female science majors, N=1048)

Variable	Simple r	b	Beta
Background Characteristics			
Expectation: Be satisfied here	.11	.36	.08
Race: Asian-American	-.13	-.75	-.08
Typology score: scholar	.10	.07	.08
College Environments			
Other college grant	.12	(.12)	(.03)
Faculty have student orientation	.41	.47	.39
Peer mean: social activism	.13	-.33	-.09
% instruction-oriented expenses	.27	.02	.09
(R= .45)			
College Experiences			
Completed at least 4 years	.14	(.87)	(.07)
Talked with faculty outside of class	.27	(.39)	(.16)
Left school or transferred	-.20	-1.16	-.16
Guest in professor's home	.29	.44	.10
Participated in campus demonstrations	.00	-.46	-.08
Elected to student office	.16	.39	.07
(R= .55)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

environment measures. This finding confirms results from a considerable body of previous research about student-faculty interaction. There is no question that the degree to which the faculty is oriented toward working with students is very strongly related to the satisfaction of students with their college science experiences. In the case of student satisfaction with facilities, the coefficient is negative, probably indicating that institutions strongly oriented towards teaching tend to be less oriented towards research and to tend have less adequate facilities.

Next, the substantively and/or statistically interesting predictors of each criterion variable are examined. Each regression will be reviewed after the college environment measures have entered. In addition, important college experience, or intermediate outcome, variables that entered subsequently will be identified.

Table 8.19
Prediction of Satisfaction Factor 2: Curriculum
(Male science majors, N=1462)

Variable	Simple r	b	Beta
Background Characteristics			
Expectation: Be satisfied here	.17	.47	.12
High school GPA	.15	.17	.11
1984 activity: felt depressed	-.12	-.37	-.10
1984 activity: was in science contest	.09	.24	.08
Choice of college	.11	(.16)	(.06)
Career choice: engineering	-.09	(-.06)	(-.02)
College Environments			
Distance from home to college	.09	(.02)	(.01)
Faculty have student orientation	.21	.11	.10
Political orientation of peers	.06	.85	.08
Lack of student community	-.23	-.33	-.12
Structured curriculum	.05	.08	.07
(R=.35)			
College Experiences			
Completed at least 4 years	.12	(.02)	(.00)
Left school or transferred	-.18	-.73	-.13
Discussed courses with other students	.14	.39	.10
College GPA	.18	.22	.11
Talked with faculty outside class	.16	.19	.09
Participated in intramural sports	.13	.17	.07
Participated in campus demonstrations	-.03	-.35	-.07
(R=43)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Prediction of satisfaction Factor 1 (faculty), Male science majors. By far the strongest predictor, with a Beta of .30, is an orientation toward students on the part of the faculty (as reported by the faculty). Faculty use of graduate teaching assistants is the next most powerful predictor (Beta = -.12) and, of course, is a negative factor. Significant background characteristics include the initial expectation to be satisfied at the college, being Anglo, having asked a teacher for advice in high school (which indicates a willingness on the part of the student to approach faculty) and, as a negative predictor, having felt depressed in high school. College experience variables related to this satisfaction factor for males include talking with faculty outside of class, discussing courses with other students, and assisting faculty in teaching. Those who received vocational

Table 8.20
Prediction of Satisfaction Factor 2: Curriculum
(Female science majors, N=1068)

Variable	Simple r	b	Beta
Background Characteristics			
Expectation: Be satisfied here	.10	(.24)	(.06)
Intellectual self-esteem	.15	.08	.13
Chicano	-.09	-1.45	-.08
College Environments			
Faculty have student orientation	.18	.15	.15
Peer mean: materialism and status	-.14	-.17	-.08
(R= .27)			
College Experiences			
Left school or transferred	-.17	-.85	-.15
Guest in professor's home	.21	.43	.13
Studying or doing homework	.13	.14	.10
College GPA	.17	.18	.09
(R=.36)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

counseling were more satisfied while those who participated in campus demonstrations were less so.

Prediction of satisfaction Factor 1 (faculty), Female science majors. Among college women, the strongest predictor of this satisfaction factor, once again, is the faculty report that they have an orientation toward students. Institutions where satisfaction was high also devote a considerable proportion of expenses to instruction and have students who score low on social activism. Significant background characteristics include the initial expectation to be satisfied and scoring high on the "scholar" typology. Asian-Americans are significantly less likely to be satisfied with their interaction with the faculty. College experiences that are positively related to this satisfaction factor include being a guest in a professor's home and being elected to student office. Once again, participating in campus demonstrations has a negative impact.

Prediction of satisfaction Factor 2 (curriculum), Male science majors. No single variable is a dramatically powerful predictor of this factor for men students. Important background characteristics include the initial expectation to be satisfied at this college, high school grade point

Table 8.21
Prediction of Satisfaction Factor 3: Facilities
(Male science majors, N=1391)

Variable	Simple r	b	Beta
Background Characteristics			
Expectation: Be satisfied here	.13	(.24)	(.05)
SAT Math score	.14	(-.0006)	(-.02)
Typology score: leader	.13	.10	.08
Choice of college	.12	.29	.09
Reason for college: get a better job	-.06	(-.22)	(-.05)
Typology score: artist	.09	(.05)	(.04)
Career choice: engineering	-.07	-.37	-.08
College Environments			
Other college grant	-.13	-.31	-.07
Distance from home to college	.14	(.04)	(.02)
Intellectual self-esteem of peers	.29	.13	.11
Women's studies course required	-.17	-1.28	-.22
Written evaluations in courses	.15	.92	.11
MBRS (minority scholarship)	-.10	-.91	-.07
Peer mean: permissiveness	.13	.26	.12
Thesis/senior project required	-.03	-.49	-.11
Lack of student community	-.17	-.60	-.20
Faculty have student orientation	-.04	-.25	-.22
Faculty positive about general education	.09	1.52	.18
% of students whose aid is based on merit	-.05	-.02	-.12
Independent research required	.12	.41	.10
Minority/third world course required	-.01	.46	.09
Peer mean: social activism	.03	-.43	-.10
(R= .48)			
College Experiences			
Worked on group project for a class	.07	.25	.08
(R= .49)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

average and participating in a science contest while in high school. The strongest environmental factor is Lack of Student Community, which is associated with lower satisfaction with the curriculum among male science students. Again, this finding reinforces the importance of the peer group in undergraduate science education. Other important environmental measures include faculty having a student orientation, the political orientation of freshman peers, and a structured curriculum. College experience variables related to this criterion include discussing course content

Table 8.22
Prediction of Satisfaction Factor 3: Facilities
(Female science majors, N=988)

Variable	Simple r	b	Beta
Background Characteristics			
Expectation: Be satisfied here	.03	(-.04)	(-.01)
SAT Math	.14	(-.0005)	(-.02)
Rating of physical health	.12	.24	.09
Choice of college	.10	.27	.08
Student: no religion	.10	(.31)	(.05)
Father's career: health profession	.09	1.47	.08
College Environments			
Progressive offerings	.22	.09	.14
Women's studies course required	-.13	-.73	-.13
Faculty positive about general education	.09	1.70	.20
Faculty committed to student development	-.20	(-.18)	(-.11)
Peer mean: outside work	-.08	-.71	-.09
Peer mean: materialism and status	-.21	-.44	-.18
Faculty have student orientation	-.09	-.26	-.23
% science faculty	.00	-.04	-.17
Over 80% men	.12	3.09	.16
Catholic institution	-.01	.76	.10
(R=.44)			
College Experiences			
Did volunteer work	.11	.14	.08
Discussed course with other students	.08	.36	.08
(R= .46)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

with other students, talking with faculty outside class, participating in intramural sports, and, as a negative factor, participating in campus demonstrations.

Prediction of satisfaction Factor 2 (curriculum), Female science majors. Here again, the variable reflecting the student orientation of the faculty is the most powerful predictor. The other predictors include Intellectual Self-esteem of the peer group and two with negative coefficients: being Chicano and having peers who are oriented toward Materialism and Status. College experience variables that related to this outcome are being a guest in a professor's home and, not surprisingly, studying or doing homework.

Prediction of satisfaction Factor 3 (facilities), Male science majors. Among the more interesting of the many significant predictors of this outcome variable are having a student oriented

Table 8.23

Prediction of Having Goal to Make a Theoretical Contribution to Science

(Male science majors, N=1468)

Variable	Simple r	b	Beta
Background Characteristics			
Initial goal to make theoretical contribution	.37	.38	.35
SAT Math	-.07	(-.0006)	(-.06)
Reason for college:prepare for grad school	.18	.11	.08
Typology score: uncommitted	.05	(.01)	(.03)
Reason for college: nothing better to do	.09	.23	.09
Outside work	.08	.04	.06
Goal: write original works	.16	.08	.06
1984: felt overwhelmed	.06	(.09)	(.05)
Reason for college: get a better job	-.06	(-.07)	(-.04)
Engineering major	-.16	-.21	-.11
College Environments			
Status of minority studies	.13	.11	.10
Faculty perception: keen competition among students	-.08	-.24	-.08
(R=.46)			
College Experiences			
Worked on individual research project	.20	.11	.10
Tutored another student	.14	.12	.08
Worked on professor's research project	.22	.17	.09
Commuting to campus	.07	.06	.08
Assisted faculty in teaching	.16	.14	.06
(R= .51)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

faculty and the percentage of students whose aid is based on merit, both as negative factors. The institutional requirement that a women's studies course be taken also is a negative predictor. Perhaps, when faculty are student oriented and a large percentage of the student body has been judged on merit criteria, the students are more likely to share faculty criticisms of computer, library and laboratory facilities. Intellectual self-esteem of the other students is a positive factor as is, surprisingly, a high score by the peer group at the institution on Permissiveness. Once again, a Lack of Student Community and having peers who are social activists both turn out to be negative predictors, while an institutional requirement that the student conduct independent research is a positive factor. Finally, having faculty who express positive opinions about general education is a positive significant predictor of this satisfaction factor.

Table 8.24
Prediction of Having Goal to Make a Theoretical Contribution to Science
(Female science majors, N=1080)

Variable	Simple r	b	Beta
Background Characteristics			
Initial goal to make theoretical contribution	.38	.36	.33
SAT Math	-.12	.00	-.13
Reason for college: prepare for grad school	.22	.13	.09
1984: performed volunteer work	-.04	-.11	-.07
Political orientation	.09	(.09)	(.07)
Biological sciences major	.23	.22	.11
College Environments			
Part-time job in college	.10	.15	.07
% faculty who worked with students on research	-.08	-.01	-.12
Use of multiple choice tests	.01	-.15	-.10
(R= .46)			
College Experiences			
Worked on professor's research project	.29	.34	.17
Worked on individual research project	.24	.10	.09
Talked with faculty outside class	.18	.08	.08
Attended racial awareness workshop	-.01	-.15	-.07
(R= .53 after college experiences)			

Notes: Coefficients presented for background characteristics and college environmental experiences are those listed after all environmental variables entered the regression equation. Coefficients for college experience variables are those listed in the last equation. Coefficients in parentheses represent those which did not remain significant.

Prediction of satisfaction Factor 3 (facilities), Female science majors. Again, the strongest predictor that emerges is the number of faculty who report a student orientation; as is the case with the men students, this variable is a negative predictor of satisfaction factor 3. Other negative environmental predictors include the percent of science faculty, having peers who are oriented toward Materialism and Status, having peers who work while in college, and having a requirement that students take a women's studies course. Positive predictors among the environmental measures include, again, institutional faculty who have positive opinions about general education, having a high proportion of male students, and being at a Catholic institution. Significant background characteristics include attending the college of one's choice and a high rating on one's physical health. Two college experience variables also were significant predictors: doing volunteer work and discussing course content with other students.

Prediction of having goal to make a theoretical contribution to science, male science majors. Only two environmental measures entered this regression: offering third world minority courses, as a positive predictor, and the faculty perception that there is keen competition among students, as a negative predictor. By far the most important predictor is entering college with an initial goal to make a theoretical contribution to science. Other interesting background characteristics include having outside work, having the goal to write original works, and not being an engineering major. Additionally, several college experience variables that reflect reference group interaction are significant predictors: tutoring another student, working on a professor's research project and assisting faculty in teaching. Not surprisingly, working on an individual research project is also related to the goal of making a theoretical contribution to science.

Prediction of having a goal to make a theoretical contribution to science, female science majors. Once again, the most powerful predictor is having an initial goal to make a theoretical contribution. The most powerful environmental predictor is the percentage of faculty who worked with students on research. However, this is a negative factor and difficult to interpret. One possibility is that female undergraduate students are sometimes used exploitively to do "scut work" rather than as apprentices in a mentor-mentee relationship. An additional surprising predictor is SAT Math score as a negative factor. This finding is especially troubling, because it suggests that some of our most mathematically competent women are being discouraged from involving themselves with scientific theory. Interestingly, majoring in the biological sciences is a positive predictor, as is attending college in order to prepare for graduate school. Significant positive college experience predictors include working on a professor's research project, working on an individual research project, and talking with faculty outside of class.

Discussion and Implications

These analyses give us much information about student attitudes, opinions, and experiences. Clearly, the experiences of science majors are different from those of students majoring in other fields. The descriptive data reinforce the observation that students' experiences with undergraduate science education differ considerably as a function of gender and ethnic background. Clearly, we need to understand better why many college students, especially women, underestimate their own ability, particularly in the area of mathematics. Why is it that only one-third of college senior women who actually are in the top ten percent of mathematical ability define themselves that way?

The results of the hierarchical regressions have implications for institutional planning and for the higher education community more generally. In recent years, there has been considerable debate in academia about the prestige and rewards for faculty associated with research versus teaching. Another debate has focused on the role of general education in the undergraduate curriculum. Following the great expansion of federal support for university research after the end of World War II, prestige in the academic world has come to be linked more closely to the "publish or perish" syndrome. Faculty who publish frequently in quality journals are much more likely to achieve tenure, be promoted, and gain recognition within and outside their institution, regardless of how much energy they invest in teaching. In a study of the correlates and predictors of national peer review departmental rankings carried out by the National Academy of Sciences, Drew and Karpf (1981), found that the departmental prestige ranking correlated .91 with one variable: the rate of publication by departmental faculty in the 20 most highly-cited journals in the field.

In recent years, the need for a greater faculty recommitment to teaching and students has been expressed by a number of leaders in the higher education community. Some writers have stressed the importance of assessing what the student actually learns in college, not merely what he or she brings to the college as an entering student (Astin, 1985). Ernest Boyer (1991) has recently argued for the need for a new kind of scholar, where teaching and research are better integrated. Heads of prestigious institutions such as Harvard and Stanford have also spoken out about the need to invigorate undergraduate teaching.

In this context, it is interesting to examine the predictors that emerge in these multiple regressions. Repeatedly, the orientation towards students on the part of the faculty emerges as a very strong predictor. Students simply are more satisfied with faculty and curriculum at institutions where the faculty values students. Furthermore, faculty can enhance student satisfaction and student commitment toward making a theoretical contribution to science by engaging in specific activities that reflect such an orientation. For example, students who report greater satisfaction with faculty and curriculum more frequently have been a guest in a professor's home. Other behavioral reflections of an orientation toward students that emerge in these regressions include the importance of students talking with faculty outside of class, assisting faculty in teaching, and working on professor's research projects. Another predictor that emerges is an institutional requirement that the student conduct an independent research project; such independent research almost always involves faculty guidance, of course.

In short, not only does a general orientation towards students on the part of the faculty repeatedly emerge as one of the strongest predictors in these equations, but also specific activities that involve student interaction with faculty emerge. Note also that in the prediction of satisfaction factor 1 (faculty), faculty use of graduate teaching assistants was a powerful negative factor. That is, activities that distanced the students from the faculty have a negative impact. A budgetary implication of faculty orientation toward students emerges as a predictor of satisfaction factor 1 for women science majors: this was the proportion of expenses devoted to instruction.

The implications for institutions are clear. At many colleges and universities there still is a need for considerable consciousness raising about the importance of students and teaching. These values, however, must be translated into behavior to have their maximum impact. Extensive use of graduate teaching assistants should be discouraged in favor of providing more continuing and direct interaction between faculty and students. Furthermore, students should be encouraged to seek out and meet with faculty after class and during office hours. Faculty should provide other opportunities for student-faculty interaction in less formal situations, for example social occasions at the faculty member's house. Institutions should encourage students to assist faculty in both teaching and research, backing this up with solid financial support. Opportunities for students to conduct independent research projects under faculty guidance should be increased. Furthermore, these results support findings from recent research by Triesman and others that suggest that students learn best when they participate in carefully structured study groups. Indeed, a lack of student community is among the strongest predictors of student dissatisfaction on two of the three satisfaction measures.

Finally, with respect to the debates about general education, it is important to note that having faculty who express positive opinions about general education is a predictor that emerged in several of these regressions equations. This occurred despite the fact that the equations used a sample consisting only of science students.

CHAPTER 9

Science Faculty: Culture, Roles, and Pedagogy

Recent literature addressing the crisis in science education in our country suggests that much of the lack of success in capturing students' interest in SME fields has to do with the way that science is taught in our institutions of higher education (Tobias, 1990, Rosser, 1990). These authors suggest that the prevailing culture in the science disciplines alienates many students who might otherwise pursue science fields. Chapter 8 of this report has also demonstrated the importance of faculty on student outcomes. Through the use of data from HERI's recent national survey of college and university faculty (1989-90), this chapter is designed to explore science faculty's educational values and pedagogical practices. Similarities and differences between the SME faculty and faculty in selected other disciplines are examined in three areas: (1) Demographic and background characteristics, (2) Information on faculty roles and classroom practices, and, (3) Information regarding the personal goals, attitudes, and behaviors of faculty.

Disciplinary differences

While faculty considered as a group share a great deal in common, they also have many distinct and interesting differences based in large part on their disciplinary affiliations. Whereas in earlier eras faculty tended to be a rather homogeneous group, contemporary faculty have become fragmented so as to comprise a multiplicity of different professional groups (Becher, 1987).

In The Academic Profession (Clark, 1987), Tony Becher expanded upon a classification system for academics developed by Biglan (1973) and grouped disciplines according to his system. These groupings are helpful in developing a better understanding of the culture that exists within the various disciplines. He proposes four major groupings of faculty: the Pure sciences or "hard-pure," the Humanities or "soft-pure," the Technologies or "hard-applied," and the Applied social sciences or "soft-applied."

The "hard-pure" group, which includes physicists and faculty from other physical sciences, views knowledge as cumulative and atomistic. This group is concerned with universals, quantities, and simplification. Knowledge should result in further discovery or explanation. Their culture is characterized as being very competitive and gregarious. This group has a very high publication rate and is very task-oriented.

The "soft-pure" group includes historians, anthropologists, and other social science disciplines. They view knowledge as reiterative and holistic, and are concerned with particulars, qualities, and complication. Knowledge results in understanding and interpretation. The culture is characterized as being very individualistic and pluralistic. It is loosely structured and person-oriented. This group tends to have a lower publication rate than the "hard-pure" group.

The "hard-applied" group includes engineers and faculty from other fields of science-technology. They view knowledge as very purposive and pragmatic. They are concerned with mastering the physical environment and in developing new products or techniques. The culture is characterized as being very entrepreneurial and cosmopolitan and is dominated by the values of the professions. In this group, patents can be substituted for publications.

Finally, the "soft-applied" group (education, social work, etc.) views knowledge as being very functional and utilitarian. They are concerned with the enhancement of professional practice. Discovery results in protocols or procedures. The culture is characterized as being very outward-looking and uncertain in status. There is a tendency to be dominated by intellectual fashions and the group tends to be very power oriented. Publication rates for this group are reduced by virtue of the fact that many of its members serve as consultants.

These differences in culture result in a number of differences in how faculty perform their jobs and in how they view the goals and purposes of higher education. While natural scientists are most likely to support the goal of career preparedness for students, faculty in the humanities are the least likely to support this as a goal (Finkelstein, 1984). Faculty from the social sciences are the strongest proponents of general education programs while faculty in natural sciences show the weakest support for such programs.

Science faculty and science education

Several scholars have recently made some rather serious criticisms about the manner in which science is currently taught at the undergraduate level. One of the purposes of analyses reported in this chapter is to test some of these claims empirically by examining the results of a recent national survey of college faculty (see section below on "results"). For example, in her work designed to assess problems in undergraduate science education in institutions of higher education, Sheila Tobias (1990) argues that no student should be allowed to leave the sciences "without a struggle." Tobias believes that much of the problem with undergraduate science education lays in students' early exposure to science. Hence, her study focused on how students experience introductory science classes. Tobias chose to look at a group of students she labeled "the second tier." Simply retaining those students who initially have high aptitude for, and high interest in, science is not enough, says Tobias, to meet the increased need for scientists in the future. As Tobias puts it, the students from the first tier are "curriculum proof." They will most likely succeed no matter what we do to them in college.

The "second tier" is comprised of students who have some aptitude for science and who have varying degrees of interest in pursuing science education. However, Tobias argues that the experience these students have with introductory college science courses drives them away from pursuing further study in science-related fields. She believes that if science education were to be restructured or reconfigured, many of these students would be interested in continuing the pursuit of undergraduate science majors.

The problems Tobias identifies with the way science is currently taught have much to do with the curriculum, method of instruction, and evaluation methods used in the classroom. She believes that introductory science courses are currently designed to weed out all but those who are in the "top tier." Science classes are extremely competitive, which proves to be intimidating for the vast majority of students. The students who participated in her study commented that one of the things they missed the most in these classes was a sense of community among the students; the extreme competitiveness simply precluded it.

Relating to the work of Becher described earlier, Tobias describes the "shared values" that scientists have and the "behavioral attributes" they value and look for in students. If a student does not possess these, she/he is destined for failure in studying science. Tobias sums up this sentiment:

> "Unless they are unusually self-motivated, extraordinarily self-confident, virtually teacher- and curriculum-proof, indifferent to material outcomes, single-minded and single-track, in short, unless they are younger versions of the science community itself, many otherwise intelligent, curious, and ambitious young people have every reason to conclude there is no place for them in science." (Tobias, p. 4)

Feminist scholars have also called for changes in the way science is taught and practiced to make it more inclusive for all students. Rosser (1990) argues that science must be transformed to make it more "female-friendly." She believes that, if such a transformation is implemented, more positive outcomes will result for all students, but particularly for women and students of color. In effect, both Rosser and Tobias seem to be calling for a pedagogy that is more "student-centered."

Rosser suggests three primary areas which need to be examined and targeted for transformation. First, language must be examined and transformed so that it is gender-neutral. Second, classroom behaviors of faculty and students must be examined and transformed so that they do not discourage the participation of women or students of color. Finally, the curriculum must be transformed (through a series of phases) so that it includes the perspectives of all people and validates their experiences and contributions.

Rosser also offers suggestions for improvement in four areas. First, is the need for less competitive models to practice science. Like Tobias, Rosser believes that the competitive nature of science practice serves to exclude many students who might otherwise be attracted to the science fields. By decreasing the competition in science, we might be better able to establish the community in the sciences that Tobias sees as lacking.

Second, Rosser believes that it is important to discuss the role of the scientist as one aspect of students' lives. Science does not necessarily have to be the all-consuming endeavor that many students are led to believe that it is. The demand for such a level of commitment can serve to scare away students who might otherwise be interested in studying science. They must be informed that it is possible to be a scientist and also to do other things.

Third, there must be increased efforts to devise strategies to reach out to non-scientists so as to remove some of the existing barriers between science and the lay person. This recommendation is similar to Tobias' recommendation that we reach out to those students who are a part of the "second tier."

Finally, Rosser believes that it is important that the practical uses of scientific discoveries be presented to students so that they may see science in its appropriate social context. This may help to demystify the role and practice of science for many of these students.

This chapter seeks to examine faculty in the sciences within the context of science "culture," with particular attention to how this culture affects the practice of science and science education in colleges and universities across the country. Providing a current profile of faculty in the sciences with respect to their values, attitudes, and classroom practices will inform this debate about the "doing" of science in colleges and universities and its consequences for undergraduate students.

Sample and Methodology

Data used for these analyses were collected as part of a recent national survey of college and university faculty and academic administrators conducted by the Higher Education Research Institute at UCLA (see Astin, Korn, & Dey, 1991).

The analyses that follow consist of a series of crosstabulations of information provided by faculty in different disciplinary groupings; biological sciences, mathematics and statistics, engineering fields, physical sciences, education, humanities, and the social sciences. These disciplinary groupings were selected to represent Becher's academic types so that differences in the cultures of the groups could be assessed. In addition to the crosstabulations done by gender, age, and institutional affiliation, regression analyses were performed to examine faculty characteristics that contribute to the use of student–centered pedagogy in the classroom.

Results

Results from the analyses of our national survey of college and university faculty will be presented separately under the following headings: Demographic/Background Characteristics; Faculty Role and Classroom Practices; Goals, Attitudes, and Behaviors; Type of Institutions; and use of Student-Centered Pedagogy. The tables referred to in this chapter are located at the end of the text.

Demographic and Background Characteristics

Not surprisingly, women continue to be underrepresented in faculty positions, and, particularly in science fields (Table 9.1). While nearly one quarter of faculty in mathematics and statistics are women, only five percent of faculty in the engineering fields are women. Women are much better represented in the three comparison fields (education, humanities, and social sciences). Differences in the representation of women in all faculty positions, and in the sciences in particular, are even more apparent when faculty are compared by age. Women, for example, are represented in higher proportions among faculty in the younger age cohorts.

Members of racial/ethnic minority groups are dramatically underrepresented in all faculty ranks (see Table 9.2).

Table 9.3 provides information pertaining to the age distribution of faculty within fields. Faculty in engineering and the physical sciences tend to be older than their colleagues in the biological sciences, mathematics, or statistics. Nearly half the faculty in engineering and physical sciences are 50 years or older. This may be in part the result of fewer replacements in these fields due to lower availability rates of new PhDs in such fields.

The Role of Faculty and Their Classroom Practices

This study was motivated in part by an interest in testing the claims, summarized above, that the "doing" of science tends to discourage students in the "second tier" from considering science as a field of study. Table 9.4 lists the teaching methods used by science faculty.

Faculty in the sciences are much less likely to utilize "active" learning methods in classroom learning (i.e., class discussions, cooperative learning techniques, student-selected topics, and student-developed learning activities). While women faculty members in science are more likely to utilize such forms of active learning more often than are men, they are still much less likely to use these pedagogical practices when compared to women faculty in nonscience fields.

Faculty in the SME fields are also more likely to use graduate teaching assistants and to depend on lecturing rather than classroom discussions. While gender differences emerge once again on these items, women faculty in the sciences are still much more similar to their male SME faculty colleagues than they are to women in the comparison fields (Table 9.5).

Another aspect of classroom practice involves the type of evaluation techniques used by faculty (see Tables 9.6 and 9.7). Faculty in the sciences are less likely to require students to complete written assignments in the form of weekly essays or term/research papers than are their colleagues in other fields. They are also less likely than are faculty in other fields to insist that students do presentations as a part of their course requirements. Finally, faculty in SME fields (with the exception of mathematics/statistics faculty) are more likely than their colleagues in other fields to grade on a curve. Grading on the curve, of course, tends to intensify competitiveness among students. Once again, significant differences between women and men SME faculty emerge with respect to evaluation methods employed.

Perhaps one of the most disturbing findings of this study is the way in which faculty view the students that they teach. While faculty in general report dissatisfaction with the quality of students they teach, science faculty are even more negative about their students than faculty in general (Table 9.8). However, women faculty overall tend to report higher levels of satisfaction with the quality of students than do the men. Younger faculty also tend to be more satisfied with the quality of students than their older faculty colleagues (see Table 9.9).

To assess further the faculty's use of alternate pedagogies, we examined whether they had taught an interdisciplinary course, worked with students on research, or team taught a course (see Table 9.10). While science faculty are much more likely to team teach and to work with students on research projects, they are less likely to offer interdisciplinary courses (with the exception of biologists) than are faculty in the humanities and social sciences. Mathematics and statistics faculty are the least likely to engage in such teaching activities.

To see how faculty in science may view the underrepresentation of students of color in science fields, we examined their interest and participation in workshops designed to increase cultural/ethnic awareness. We found that science faculty, compared to faculty in other fields, are less likely to participate in such workshops. Women, on the other hand, are more likely to report attending these workshops than men are. But even women faculty in the sciences are only half as likely to do so when compared to women in other fields (see Table 9.10).

Table 9.11 presents comparisons by discipline and gender regarding faculty members' interest in teaching versus research. Faculty in the sciences and engineering are more likely to report a stronger interest in and preference for research than teaching compared to faculty in other fields. Men are more likely to report a higher interest in research than are women in the sciences and other disciplines. Differences in how women and men value research are more apparent when we look at each group by age cohort (see Table 9.12). Women from the earlier cohorts are less likely to report that the goal of engaging in research is very important or essential to them. However, both younger men and women are quite research-driven in their orientation compared to older faculty.

Finally, Table 9.13 provides a summary of how faculty conduct research by discipline and gender. Faculty in the sciences are more likely than faculty in other fields to collaborate. Women in science disciplines are slightly more likely to collaborate with others in their research than are men. They are also more likely to collaborate than women colleagues in other disciplines.

Goals, Attitudes, and Behaviors of Faculty

The attitudes of faculty toward their work may have much to do with how they interact and relate to the students they teach. In order to learn more about the culture of the faculty in scientific disciplines, we considered what they value in their work and in their personal lives.

Table 9.14 summarizes faculty attitudes by discipline and gender relating to a set of selected goals for undergraduate education. Faculty in science fields are less likely than faculty in other disciplines to value the student's personal development as an important goal of undergraduate education. At the same time, science faculty seem to be more concerned with the practical elements of undergraduate education (i.e., preparation for employment and for graduate education). For the most part, these orientations are evident in science faculty of both genders. With few exceptions, men and women tend to closely agree on these items.

With respect to personal goals, faculty in the sciences are less likely than their colleagues in other disciplines to be concerned with or involved in the solution of societal problems (i.e., influencing the political structure, influencing social values, and helping to promote racial understanding (see Table 9.15). Women faculty in the sciences, however, tend to be somewhat more supportive of such goals than are their male colleagues.

Faculty in engineering fields seem to be highly concerned with status (i.e., becoming an authority in own field, being very well-off financially). Compared to other science faculty, they are also at the lower end of the continuum of concern with the social issues described above.

Differences among Science Faculty by Type of Institution

In addition to differences by disciplinary affiliation in how faculty approach their work, what faculty value in their work, and how they interact with their students, differences in the type of institution where they teach also can have an effect on faculty roles and how they approach their work. For this reason, we compared views and behaviors of faculty employed by four different types of institutions: public universities, private universities, public four year colleges, and private four year colleges.

While women are dramatically underrepresented in the sciences as a whole, their underrepresentation is greatest in the public and private universities (see Table 9.16). While there are similar gender differences by type of institution in other disciplines, these differences are smaller than those in science and science-related fields.

Faculty employed at public and private universities are most likely to report that their principal role is to conduct research (10 to 28 percent; see Table 9.17). Conversely, no less than 95 percent of faculty at the public and private four year colleges report that their principal activity is teaching (see Table 9.18). As would be expected, faculty at universities are more likely to report that they are satisfied with opportunities available to them for scholarly pursuits (see Table 9.19). Faculty in science fields are also more likely than their colleagues in other fields to report that they engage students in their research activities. Faculty at the universities are most likely to report that they involve their students in research (see Table 9.20). However, there is no way to determine whether this research involves undergraduate or graduate students, or some combination of both. There is also no way to determine the nature of such involvement.

Differences based upon the type of institution at which faculty were employed are also evident in what faculty said they value in their work. Faculty at the public and private universities are more likely to report that they value the goal of engaging in research (ranging from 75 to 89 percent very important or essential) as compared to faculty at the four year colleges (ranging from 33 to 64 percent, see Table 9.21). As would be expected, faculty at the four year colleges are more likely to value the goal of being a good teacher (from 76 to 85 percent report "essential") as compared to faculty at the universities (from 59 to 69 percent "essential," see Table 9.22).

Not surprisingly, faculty at universities are more likely than are faculty at the four year colleges to report that they use graduate teaching assistants in all or most of their classes (see Table 9.23). Given that four year colleges usually have no graduate programs in the sciences, we might assume that faculty at the four year colleges would be more likely to report using undergraduate teaching assistants. This is the case, however, only for the private four year colleges (see Table 9.24).

There were two differences in the classroom evaluation techniques primarily used by SME faculty that merit mention. Faculty at the four year colleges are more likely than university faculty to report that they require students to give presentations in class (see Table 9.25). While faculty in the sciences tend to grade on the curve more often than their colleagues in most other fields, this practice is relatively less prevalent among science faculty who teach at public four year colleges (see Table 9.26).

Finally, two variables relating to how faculty view their students reveal interesting differences based upon institutional affiliation: Faculty at private institutions (colleges or universities) are more likely to report that they are satisfied with the overall quality of their undergraduates than are faculty at public institutions (see Table 9.27). The last difference among faculty has to do with the value that they place on issues of diversity on campus. Faculty at public and private four year colleges are more likely to attend faculty development workshops on topics of racial awareness (see Table 9.28). While faculty in the sciences attend such workshops less often than do their peers in other disciplines, science faculty at the four year colleges are two to three times more likely to attend these workshops than are their peers in the universities.

Predicting The Use of Student Centered Pedagogy

Based on faculty responses to two sets of items relating to evaluation methods and instructional techniques, we extracted a factor labeled student-centered pedagogy. The items that loaded positively on this factor included the following: student presentations, student evaluations of each other's work, class discussions, cooperative learning (small groups), experiential learning/field studies, group projects, independent projects, student-developed activities (assignments, exams, etc), and student-selected topics for course content. The use of extensive lecturing loaded negatively on the factor.

Since active forms of learning have been found to have a positive impact on student learning and growth (Study Group, 1984), we believed that identifying what faculty characteristics and what types of institutions may be conducive to the use of such pedagogical approaches can lead to some useful recommendations for faculty development and for institutional change. Accordingly, we conducted a stepwise regression to identify faculty characteristics (independent variables) that predict use of active learning techniques (dependent variable). While we anticipated that age and rank as well as type of employer institution would play an important role in whether faculty used active learning techniques, none of these variables entered the regression equation as significant predictors. Instead the variables that are associated with the use of student-centered pedagogy include the use of "new" course content: readings in Women's and ethnic studies, participating in racial awareness workshops, and taking courses focusing on Women's or minority issues. Women and faculty of color are most likely to use such pedagogical approaches. Other positive predictors include team teaching or teaching interdisciplinary courses. Heavy leaning toward research (versus teaching) was a negative predictor of the use of student-centered pedagogy. It thus appears that faculty who maintain a balance between teaching and research may be the ones most likely to employ active forms of learning. Not surprisingly, faculty at large institutions are unlikely to use student-centered pedagogy (see Table 9.29).

From this analysis we are able to surmise that science faculty who are more aware and sympathetic to diversity concerns and who are willing to expand and transform their course content and to engage in interdisciplinary and team teaching are also the kind of faculty who are likely to employ more active and student-centered approaches in their teaching.

Summary and Implications

A number of other researchers have already identified aspects of science education that might act as barriers to access and persistence in science for college students, especially women and students of color. Among the many areas of possible concern are the curriculum and pedagogy used as well as the overall "culture" of science and the faculty's beliefs and attitudes about who can do science and what it takes to become a scientist.

Our analysis offers empirical confirmation for many of the observations offered by others. Compared to faculty in other fields, science faculty use more hierarchical and authoritarian approaches in the classroom than do their counterparts in other disciplines and are less likely to be student-centered in their pedagogy. Specifically, science faculty are less likely to involve students in classroom discussions, in cooperative learning, or in the selection of topics—all forms of active learning. They are also more likely than nonscience faculty to lecture, to use multiple choice exams, and to feel that the quality of their students is quite poor. They are less interested in students' personal development and are personally less concerned with society's ills and problems. Not surprisingly, science faculty are also more likely to indicate that their own interests lean more toward research than teaching.

Faculty in the physical sciences and engineering tend to be somewhat older than faculty in the biological sciences and in mathematics. In part, these differences are a function of the larger proportion of women in these latter fields (women academics are in higher proportion among the newcomers, and thus among the younger cohorts).

That younger science faculty are more satisfied with the quality of their students than are their older colleagues can be explained by the fact that older faculty have taught earlier generations of students who may have been better prepared to do college level work. However, the fact that the younger generation of science faculty are much more research-driven may have important implications for undergraduate science education, since the younger faculty may be the ones most often assigned to teach the introductory science courses.

The institutional comparisons provide a number of insights as to the specific types of educational experiences which undergraduates as a group, and, science majors in particular, have as they engage in undergraduate science study at different types of institutions. Beyond the more obvious results—the frequent use of graduate teaching assistants, the larger classes, and the strong inclination toward research among faculty at the universities—we find fewer opportunities for meaningful contact with faculty members among university students when compared to their peers who attend four year colleges (Astin, 1993). All of these factors may combine to create an environment that serves to alienate university students and discourage them from science study.

Faculty at the four year colleges are also more likely to value (or to have increased sensitivity to) issues of diversity than are their colleagues from the universities. Hence, the climate in the sciences experienced by students from underrepresented groups is probably somewhat more supportive at the four-year colleges than at the universities.

Given that the science faculty are predominantly white and male, women students and students of color have limited opportunities to find faculty role models.

These findings also suggest that the typical environment for science education in American colleges and universities tends to be impersonal, competitive, and authoritarian. Such an environment may well serve to discourage many students from studying science, especially those who may feel underprepared or who may have doubts about their ability to succeed in science.

The apparent effectiveness of active and cooperative learning in enhancing students' intellectual engagement and growth (Johnson, Johnson, & Smith, 1991; Treisman, 1983, 1990; Study Group, 1984) suggests that it may be useful to encourage faculty to change the way they teach sciences. The practical question remains, of course, of how to initiate such transformations. One important first step is to disseminate more widely the data reported in this chapter. It is also important to find ways to encourage science faculty to observe one another in the classroom and to engage in regular discussions about pedagogy.

Institutional leadership also has an important role to play here. The regression analyses, for example, indicate that faculty are much more likely to use active forms of teaching and learning if they work in an environment that encourages interdisciplinary work, team teaching and the incorporation of women's and ethnic perspectives in the curriculum. Indeed, a general campus climate of concern with issues of diversity seems to encourage the use of student-centered pedagogy.

Table 9.1
Discipline by Gender

	Men	Women
Biological Sciences	77.3	22.7
Engineering	94.7	5.3
Math/Statistics	75.8	24.2
Physical Sciences	88.9	11.1
Education	52.7	47.3
Humanities	67.4	32.6
Social Sciences	72.5	27.5
All Faculty	68.5	31.5

Table 9.2
Discipline by Racial Group

	White	Black	American Indian	Asian	Chicano	Puerto Rican
Biological Sciences	92.7	2.2	.9	3.4	.2	.5
Engineering	85.1	1.0	.5	9.3	.3	.1
Math/Statistics	89.9	2.4	.6	4.7	.6	.3
Physical Sciences	92.4	1.4	.5	4.2	.2	.1
Education	91.5	5.1	.7	1.0	.8	.7
Humanities	91.7	1.6	.7	1.8	1.2	.6
Social Sciences	89.5	3.9	1.2	3.1	1.1	.5
All Faculty	91.4	3.0	.8	2.8	.7	.4

Table 9.3
Discipline by Age

	29 or less	30-39	40-49	50-59	60 or more
Biological Sciences	1.1	19.2	40.4	27.7	11.5
Engineering	1.9	25.4	27.1	30.9	14.0
Math/Statistics	4.1	20.9	36.4	28.5	10.2
Physical Sciences	2.2	20.2	31.9	33.3	12.4
Education	2.6	20.1	35.0	31.0	11.4
Humanities	2.1	22.4	33.5	28.6	13.6
Social Sciences	2.1	23.7	38.3	25.0	10.8
All Faculty	2.4	22.8	36.3	27.7	10.8

Table 9.4

Comparison of Instructional Techniques by Discipline (Percent indicating method used in all or most classes taught)

	Class Discussion	Cooperative Learning	Graduate T.A.'s	Undergrad T.A.'s	Group Projects	Extensive Lecturing	Stu Develop Activities	Stu Selected Topics
Biological Sciences	42.4	12.7	15.3	7.7	11.2	80.5	8.4	4.4
Engineering	45.1	13.9	17.9	3.9	16.2	77.7	15.0	2.7
Math/Statistics	42.4	11.0	4.7	5.1	3.3	76.7	17.1	1.7
Physical Sciences	41.9	12.4	13.0	8.8	5.1	82.4	8.6	2.4
Education	80.3	46.8	3.5	2.3	27.3	29.8	24.1	15.9
Humanities	80.0	28.1	2.7	2.8	10.0	35.6	13.1	8.0
Social Sciences	73.2	21.4	7.0	2.8	11.7	64.1	10.3	7.1
All Faculty	70.1	27.0	6.0	3.3	15.7	53.9	14.9	8.3

Table 9.5

Comparison of Instructional Techniques by Disciplinary Affiliations and Gender (Percent indicating method used in all or most classes taught)

	Class Discussion		Cooperative Learning		Graduate T.A.'s		Undergrad T.A.'s		Group Projects		Extensive Lecturing		Stu Develop Activities		Stu Selected Topics	
	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W
Biological Sciences	42.4	42.1	16.1	22.9	15.8	13.3	7.1	10.1	10.3	13.9	80.7	79.5	8.6	7.4	4.1	5.5
Engineering	44.8	51.5	13.4	21.2	18.0	16.7	3.8	6.0	16.2	16.7	78.1	71.2	14.9	16.7	2.9	0.0
Math/Statistics	48.6	48.0	8.5	18.5	5.7	1.5	5.5	4.0	2.7	5.3	79.6	67.2	16.1	20.3	1.4	3.0
Physical Sciences	41.9	41.8	11.7	16.9	13.3	10.2	9.1	7.0	5.0	5.8	83.2	75.5	8.0	13.5	2.1	4.4
Education	79.6	81.1	39.6	54.8	4.2	2.7	2.1	2.3	23.4	31.5	35.5	23.6	20.8	27.8	14.8	17.0
Humanities	78.5	83.3	20.2	44.5	2.9	2.3	2.4	3.4	6.9	16.3	43.7	18.9	11.3	16.8	7.4	9.3
Social Sciences	69.7	82.5	16.1	35.3	7.1	6.7	2.5	3.5	9.2	18.5	68.7	51.9	9.3	12.9	6.1	10.0
All Faculty	66.7	77.5	20.7	40.9	7.0	4.0	3.6	2.8	12.9	21.8	59.8	41.3	13.1	18.8	7.0	11.3

Table 9.6

Comparison of Evaluation Methods Used by Discipline (Percent indicating method used in all or most classes taught)

	Mult Choice Mid/Final	Essay Mid/Final	Short Answer Mid/Final	Mult Choice Quizzes	Short Answer Quizzes	Weekly Essays	Student Presentations	Term/Research Papers	Grading on Curve	Competency Based Grading
Biological Sciences	43.0	37.4	41.3	21.0	30.5	5.8	13.6	22.7	32.8	44.6
Engineering	9.7	21.0	34.9	4.5	21.3	13.8	15.2	18.8	42.9	62.2
Math/Statistics	10.1	21.0	34.9	2.4	38.6	12.5	7.2	4.1	23.0	58.8
Physical Sciences	24.5	25.8	43.3	9.8	33.5	10.4	7.8	11.7	41.2	51.4
Education	45.4	42.0	36.1	22.4	25.6	15.0	43.2	37.3	13.3	49.8
Humanities	14.3	58.3	33.9	7.1	6.5	16.1	28.2	38.7	15.2	52.2
Social Sciences	41.4	49.6	32.5	17.9	14.7	9.4	21.4	43.0	29.1	45.1
All Faculty	31.9	42.6	34.4	15.3	24.4	14.1	26.8	33.2	22.0	51.6

Table 9.7

Comparison of Evaluation Methods by Discipline by Gender (Percent indicating method used in all or most classes taught)

	Mult Choice Mid/Final		Essay Mid/Final		Short Answer Mid/Final		Mult Choice Quizzes		Short Answer Quizzes		Weekly Essays		Student Presentations		Term/Research Papers		Grading on Curve		Competency Based Grading	
	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W	M	W
Biological Sciences	41.9	43.8	37.3	37.4	41.8	39.5	20.9	21.2	28.8	36.3	5.5	6.7	12.2	18.6	22.2	24.2	34.0	28.4	44.8	43.8
Engineering	9.9	6.0	21.0	23.1	34.6	40.0	2.4	2.3	20.3	27.5	13.8	12.3	14.7	24.2	18.1	30.3	34.0	28.4	44.8	43.8
Math/Statistics	9.2	12.5	22.8	18.6	47.3	50.6	2.4	2.3	36.2	46.0	10.8	6.7	6.5	9.1	3.8	4.8	25.7	14.9	58.7	59.3
Physical Sciences	24.4	24.6	26.0	24.3	42.3	50.5	9.9	9.8	31.9	45.3	10.8	6.7	7.1	13.2	11.1	16.4	42.1	34.6	52.1	45.9
Education	46.7	44.0	40.2	44.0	33.6	38.8	23.1	21.5	23.7	27.5	13.2	16.9	38.7	48.4	38.8	35.6	16.7	9.9	47.2	52.7
Humanities	15.7	11.2	59.6	55.4	32.6	36.6	7.3	6.6	23.9	31.9	13.0	22.3	21.6	41.8	41.3	33.2	16.3	12.9	51.7	48.0
Social Sciences	42.8	38.1	48.7	51.8	32.3	33.1	18.3	16.7	14.2	16.1	8.7	11.0	17.7	31.4	40.3	50.2	31.2	23.8	44.5	46.8
All Faculty	29.4	27.4	42.9	41.8	35.3	32.6	14.0	18.4	23.7	25.9	12.2	18.0	22.0	37.1	31.5	36.6	25.3	14.5	50.7	53.6

Table 9.8

Faculty Satisfaction with Quality of Students by Departmental Affiliation and Gender

(Percent responding satisfied or very satisfied)

	All	Men	Women
Biological Sciences	35.3	33.7	40.9
Engineering	34.7	34.4	40.0
Math/Statistics	33.6	33.1	35.3
Physical Sciences	31.5	30.5	39.3
Education	56.0	55.4	56.7
Humanities	43.5	41.3	48.3
Social Sciences	38.5	36.2	44.7
All Faculty	39.9	37.0	46.1

Table 9.9

Satisfaction with Quality of Students by Gender and by Age Cohort-Selected disciplines (Percentage responding satisfied or very satisfied)

	34 or less		35-44		45-54		55-64		65 and older	
Department	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Biological Sciences	47.3	53.0	33.6	40.3	31.9	40.2	33.6	24.0	35.7	16.7
Engineering	32.4	41.4	33.4	40.7	35.7	50.0	31.7	0.0*	40.8	0.0*
Math/Statistics	37.0	39.2	30.3	34.2	27.4	35.2	26.7	27.2	27.8	62.5
Physical Sciences	42.3	42.5	32.1	44.9	27.4	36.3	29.9	32.1	29.2	16.7
Education	55.5	54.4	57.0	57.6	55.8	58.2	53.2	53.7	65.1	51.8
Humanities	46.7	53.2	44.3	45.4	38.4	50.5	34.0	42.3	42.0	53.1
Social Sciences	37.6	47.1	40.1	46.3	34.1	42.3	34.0	42.3	30.7	36.3
All Faculty	40.3	48.9	37.5	47.3	36.1	44.7	36.8	42.5	40.6	44.8

Table 9.10

Attended Racial Awareness Workshop by Discipline and Gender

Discipline	All	Men	Women
Biological Sciences	19.9	17.9	26.8
Engineering	12.5	11.8	24.2
Math/Statistics	17.0	14.8	23.9
Physical Sciences	15.6	15.2	19.2
Education	39.7	35.2	44.4
Humanities	33.2	28.8	48.0
Social Sciences	33.8	23.5	48.0
All Faculty	28.7	23.5	39.7

Table 9.11

Interest in Teaching versus Research by Discipline and Gender

	Teaching			Research		
	All	Men	Women	All	Men	Women
Biological Sciences	69.2	66.9	77.4	30.8	33.1	22.6
Engineering	62.9	62.7	66.7	37.1	37.3	33.3
Math/Statistics	80.1	77.2	91.3	19.9	22.8	8.7
Physical Sciences	70.2	69.1	78.1	29.8	30.9	21.9
Education	88.8	88.0	89.7	11.2	12.0	10.3
Humanities	69.5	69.3	69.9	30.5	30.7	30.1
Social Sciences	66.4	66.1	67.5	33.6	33.9	32.5
All Faculty	75.4	72.9	80.8	24.6	27.1	19.2

Table 9.12

Importance of Faculty Goal to Engage in Research by Gender and by Age Cohort-Selected disciplines (Percentage reporting very important or essential)

	34 or less		35-44		45-54		55-64		65 and older	
Department	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Biological Sciences	77.3	64.8	74.9	63.2	60.9	45.6	56.4	38.0	66.7	33.3
Engineering	85.0	89.6	78.1	62.9	60.7	83.3	58.3	100.0	58.9	0.0
Math/Statistics	72.4	33.8	61.0	30.3	36.1	19.5	32.8	30.4	50.0	6.7
Physical Sciences	83.0	72.9	75.9	79.5	61.1	54.0	56.9	33.3	60.0	16.7
Education	48.5	45.7	49.9	53.5	38.2	42.1	36.5	37.2	40.5	16.7
Humanities	80.0	77.7	80.7	77.5	69.4	64.8	65.0	59.2	70.4	43.7
Social Sciences	85.5	78.7	76.9	77.5	59.9	62.9	55.8	54.6	67.0	70.9
All Faculty	72.2	61.1	67.5	58.9	55.6	48.9	51.1	45.5	55.5	42.1

Table 9.13
Type of Research Working Environment by Discipline and Gender

	Alone			One or Two Others			Research Group		
	All	Men	Women	All	Men	Women	All	Men	Women
Biological Sciences	61.5	61.8	60.6	31.1	31.2	30.7	7.4	7.0	8.7
Engineering	58.5	58.7	54.7	35.6	35.3	42.2	5.9	5.5	9.0
Math/Statistics	68.2	69.5	63.8	25.5	25.0	27.1	6.3	5.5	9.0
Physical Sciences	60.5	60.6	59.8	32.4	32.2	34.0	7.1	7.2	6.3
Education	63.4	64.3	62.4	26.6	24.9	28.4	10.0	10.7	9.2
Humanities	86.2	86.3	85.9	10.4	10.2	10.9	3.4	3.5	3.2
Social Sciences	67.8	69.0	64.6	28.4	27.6	30.6	3.8	3.4	4.8
All Faculty	69.5	70.5	67.2	23.9	23.8	24.2	6.6	5.7	8.6

Table 9.14

Goals of Undergraduate Education by Discipline and Gender (Percentage indicating essential or very important)

	Prepare for Employment			Prepare for Graduate Education			Develop Moral Character			Provide for Emotional Development			Teach Personal Values			Enhance Self-Understanding		
	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women
Biological Sciences	51.1	56.0	49.7	66.4	66.7	65.4	51.6	51.4	51.8	33.1	33.7	34.3	56.4	54.9	61.5	57.2	56.3	60.1
Engineering	78.6	83.1	78.4	50.0	49.9	53.9	57.4	57.8	50.7	28.0	28.2	24.6	54.5	54.5	55.4	47.8	47.7	61.6
Math/Statistics	59.5	70.2	56.0	56.5	55.8	58.9	56.4	55.5	57.4	31.3	27.5	43.1	50.9	48.2	59.0	51.9	48.9	49.2
Physical Sciences	59.2	67.8	58.4	67.7	67.6	68.8	48.7	48.4	51.1	27.5	26.5	35.7	50.2	50.1	51.0	47.5	46.8	53.3
Education	80.9	83.9	78.4	52.5	51.1	53.9	68.7	66.9	70.6	61.6	58.5	65.1	78.5	77.2	80.0	83.4	80.4	86.6
Humanities	38.2	45.6	34.7	50.0	48.1	54.2	64.0	63.8	64.3	42.1	40.0	46.7	73.1	73.1	73.1	78.1	77.7	78.7
Social Sciences	45.0	50.2	43.0	54.0	53.3	53.6	46.5	45.3	59.8	31.7	29.2	38.2	56.9	54.4	63.5	64.6	77.7	71.8
All Faculty	60.1	67.9	56.6	52.2	51.7	53.3	58.0	55.8	62.9	40.6	36.4	50.0	65.5	62.5	72.0	68.7	64.9	76.9

Table 9.15

Personal Goals by Discipline and Gender (Percentage indicating essential or very important)

	Become Authority in Own Field			Influence Political Structure			Influence Social Values			Be Very Well-Off Financially			Help Others in Difficulty			Help Promote Racial Understandiing		
	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women
Biological Sciences	56.9	58.4	51.4	14.5	14.6	14.1	35.0	33.0	38.5	29.3	31.1	22.9	62.7	60.5	70.4	53.6	51.9	58.4
Engineering	70.9	67.9	71.2	13.3	13.6	9.1	27.9	28.0	27.3	41.2	42.0	26.2	62.4	62.1	66.7	44.8	44.3	53.0
Math/Statistics	47.8	48.5	45.7	9.7	10.2	8.5	27.1	25.0	33.5	28.4	29.0	21.9	60.8	58.4	72.8	49.0	46.0	59.0
Physical Sciences	55.7	57.1	45.7	11.0	11.4	8.2	26.5	26.4	27.3	28.3	29.3	21.9	60.8	60.4	64.0	47.0	45.7	57.9
Education	67.9	68.4	67.5	20.0	19.2	21.0	59.1	56.3	62.3	38.8	40.2	37.1	78.3	77.7	78.8	66.3	62.8	70.3
Humanities	63.1	64.6	60.2	23.4	22.3	25.8	61.3	59.2	65.7	22.7	22.6	22.7	71.3	70.1	73.7	75.6	73.0	80.7
Social Sciences	62.6	62.1	63.7	27.4	24.0	36.1	55.5	50.9	67.5	30.5	32.8	24.7	64.5	61.6	62.8	66.7	62.8	76.9
All Faculty	63.7	63.6	64.0	19.9	18.3	23.2	48.0	43.5	57.8	32.9	33.3	30.9	68.2	65.3	74.5	61.1	57.7	69.1

Table 9.16

Percentage of Women Faculty by Discipline and Institutional Type

	Public University (N=7751)	Private University (N=2229)	Public College (N=8309)	Private College (N=11672)
Biological Sciences	16.7	12.1	18.1	29.6
Engineering	4.7	4.5	7.1	6.2
Math/Statistics	12.8	14.7	23.3	26.3
Physical Sciences	7.6	6.5	9.7	13.9
Education	41.4	44.9	42.8	51.5
Humanities	31.6	33.3	31.8	32.9
Social Sciences	24.6	28.2	23.5	29.7
All Faculty	27.1	26.2	29.2	33.7

Table 9.17

Faculty who report principal activity as research (Percentages)

	Public University (N=7584)	Private University (N=2190)	Public College (N=8243)	Private College (N=11597)
Biological Sciences	27.8	26.3	2.6	0.6
Engineering	13.0	10.3	4.0	0.0
Math/Statistics	19.5	29.4	1.7	0.7
Physical Sciences	22.7	14.5	1.2	0.7
Education	4.5	1.3	0.7	0.0
Humanities	7.2	7.3	0.7	0.6
Social Sciences	17.7	16.1	1.7	0.9
All Faculty	12.1	10.6	1.1	0.5

Table 9.18

Faculty who report principal activity as teaching (Percentages)

	Public University (N=7584)	Private University (N=2190)	Public College (N=8243)	Private College (N=11597)
Biological Sciences	69.5	67.7	95.1	98.0
Engineering	83.8	85.9	92.0	97.2
Math/Statistics	78.0	66.1	97.3	97.8
Physical Sciences	73.3	83.3	96.7	98.6
Education	87.9	93.4	90.1	87.5
Humanities	88.1	90.6	96.6	96.7
Social Sciences	78.3	82.2	95.5	97.0
All Faculty	82.9	85.8	94.3	95.6

Table 9.19

Satisfaction with opportunity for scholarly pursuits (Percentage satisfied or very satisfied)

	Public University (N=7483)	Private University (N=2165)	Public College (N=8044)	Private College (N=11244)
Biological Sciences	59.7	56.6	37.8	36.0
Engineering	56.7	66.2	48.2	37.6
Math/Statistics	61.1	62.0	45.0	45.9
Physical Sciences	60.6	67.2	35.1	43.5
Education	44.4	56.6	40.5	41.8
Humanities	50.2	54.5	32.0	38.1
Social Sciences	55.7	54.1	35.5	38.1
All Faculty	53.0	56.8	37.0	39.5

Table 9.20

Worked with students on research (Percent responding yes)

	Public University (N=7285)	Private University (N=2106)	Public College (N=7609)	Private College (N=10628)
Biological Sciences	91.8	90.8	85.7	85.1
Engineering	91.3	87.2	86.1	79.7
Math/Statistics	54.4	54.0	37.4	37.0
Physical Sciences	90.9	93.4	78.1	77.0
Education	77.9	71.0	61.6	47.6
Humanities	59.5	61.2	48.6	53.3
Social Sciences				
All Faculty	76.3	75.1	65.5	62.0

Table 9.21

Faculty goal: Engage in research (Percent responding very important or essential)

	Public University (N=7586)	Private University (N=2189)	Public College (N=8165)	Private College (N=11480)
Biological Sciences	85.5	85.7	62.3	60.1
Engineering	78.5	75.0	64.2	57.6
Math/Statistics	77.1	79.9	40.5	33.3
Physical Sciences	88.6	88.7	63.9	62.8
Education	63.6	71.4	43.2	36.9
Humanities	84.4	84.0	69.7	67.8
Social Sciences	87.2	87.0	65.8	65.1
All Faculty	77.8	79.5	57.1	56.2

Table 9.22

Faculty goal: Be a good teacher (Percentage responding essential)

	Public University (N=7589)	Private University (N=2129)	Public College (N=8177)	Private College (N=11512)
Biological Sciences	64.3	68.7	83.2	85.3
Engineering	67.9	69.2	76.4	77.8
Math/Statistics	68.9	59.6	78.8	84.4
Physical Sciences	66.9	64.4	82.9	84.6
Education	81.1	78.2	88.9	90.7
Humanities	78.7	84.0	87.3	89.3
Social Sciences				
All Faculty	72.5	72.6	83.7	86.5

Table 9.23

Instructional technique: Use of graduate teaching assistants (Percentage reportng used in all or most classes)

	Public University (N=7487)	Private University (N=2165)	Public College (N=8121)	Private College (N=11440)
Biological Sciences	44.9	57.3	6.1	2.2
Engineering	24.7	30.3	11.8	2.1
Math/Statistics	17.2	23.4	1.9	0.1
Physical Sciences	42.6	42.6	5.3	1.4
Education	9.8	11.9	2.1	1.2
Humanities	7.9	7.7	1.2	0.4
Social Sciences	18.9	23.5	3.0	1.2
All Faculty	17.1	20.1	3.0	0.8

Table 9.24

Instructional technique: Use of undergraduate teaching assistants (Percentage reportng used in all or most classes)

	Public University (N=7470)	Private University (N=2156)	Public College (N=8119)	Private College (N=11451)
Biological Sciences	5.7	7.3	1.6	15.1
Engineering	5.2	4.5	2.0	2.1
Math/Statistics	4.2	3.8	3.8	8.9
Physical Sciences	3.6	3.7	5.6	16.4
Education	2.4	1.3	1.5	2.7
Humanities	1.2	1.7	0.7	4.4
Social Sciences	2.8	1.8	1.3	4.7
All Faculty	2.9	3.3	2.2	5.2

Table 9.25

Evaluation method:Student presentations (Percentage reportng used in all or most classes)

	Public University (N=7483)	Private University (N=2150)	Public College (N=8150)	Private College (N=11463)
Biological Sciences	11.4	11.5	11.5	18.7
Engineering	14.4	14.2	20.7	14.0
Math/Statistics	3.3	3.9	8.8	10.1
Physical Sciences	6.4	5.3	7.4	9.6
Education	42.0	50.7	44.4	49.7
Humanities	23.8	27.1	28.1	30.4
Social Sciences	15.9	19.0	18.7	27.9
All Faculty	25.5	24.7	28.3	31.0

Table 9.26

Evaluation method: Grading on a curve (Percentage reportng used in all or most classes)

	Public University (N=7468)	Private University (N=2156)	Public College (N=8121)	Private College (N=11432)
Biological Sciences	42.3	37.1	32.1	31.9
Engineering	47.5	45.8	38.3	46.9
Math/Statistics	36.0	25.7	19.9	24.1
Physical Sciences	49.4	45.2	39.6	41.3
Education	13.6	18.7	13.5	13.2
Humanities	15.3	18.0	14.9	14.7
Social Sciences	32.7	35.6	29.5	27.8
All Faculty	28.3	27.5	21.9	20.2

Table 9.27

Satisfaction with quality of students (Percentage satisfied or very satisfied)

	Public University (N=7546)	Private University (N=2184)	Public College (N=8148)	Private College (N=11416)
Biological Sciences	33.1	61.6	21.1	45.1
Engineering	32.2	45.6	35.0	42.4
Math/Statistics	23.4	43.2	26.0	40.4
Physical Sciences	25.3	40.3	24.0	40.5
Education	51.8	72.8	53.9	63.0
Humanities	34.5	60.4	30.9	49.1
Social Sciences	30.3	53.8	32.0	48.4
All Faculty	37.3	55.2	34.7	47.0

Table 9.28
Attended a racial awareness workshop (Percent responding yes)

	Public University (N=6712)	Private University (N=1905)	Public College (N=7208)	Private College (N=10105)
Biological Sciences	12.7	12.4	21.9	21.3
Engineering	8.9	9.4	15.7	10.5
Math/Statistics	8.9	4.3	14.7	19.7
Physical Sciences	6.3	6.0	18.3	17.3
Education	36.1	21.9	43.2	38.2
Humanities	25.8	23.4	33.1	37.2
Social Sciences	24.4	21.1	35.3	37.1
All Faculty	21.3	18.8	30.9	30.5

Table 9.29
Predictors of Student Centered Pedagogy

Variable	r	Beta
Used readings on Women/gender issues	.23	.09
Taught an interdisciplinary course	.21	.14
Participated in Women's/minority course	.19	.10
Team taught a course	.19	.12
Used readings on racial/ethnic issues	.23	.09
Gender: Female	.08	.07
Being heavily interested in teaching	-.08	-.08
Total enrollment	-.07	-.07
Done research on race/ethnicity	.12	.05
Attended racial/cultural awareness workshop	.14	.05
Race: White	-.06	-.04
Taught ethnic studies course	.06	-.05
Race: American Indian	.06	.04
Number of general education courses taught	-.02	-.04
R = .39		

Note: All Betas are significant at .001 level in last solution

CHAPTER 10

The Site Visits

To further explore the influence of specific college environments on persistence in and recruitment to the sciences, we visited several institutions that were part of the sample used in the quantitative analyses. These schools were selected based on their having strong positive effects which could not be explained by environmental variables included in the statistical analyses. Five site visit institutions were chosen specifically for their positive effects in three areas: (1) attracting students to science majors; (2) maintaining students in the science majors; and, (3) encouraging students to pursue science careers. However, it is important to note that other schools also exhibited positive effects on students that could not be explained by our data. Indeed, several colleges and universities in our sample appeared to have successful science programs. Criteria for choosing the institutions included important characteristics in addition to their undergraduate science programs. The institutions were chosen to: (1) represent different regions of the country; (2) represent both public and private institutions; (3) represent different institutional priorities (i.e., teaching vs. research); and (4) represent different sizes of undergraduate enrollments. The five institutions chosen were: Johns Hopkins University (Baltimore, Maryland); Case Western Reserve University (Cleveland, Ohio); Albion College (Albion, Michigan); Santa Clara University (Santa Clara, California); and Georgia Institute of Technology (Atlanta, Georgia).

The positive effects that were found for each institution are identified in Tables 10.1 through 10.5. The tables also indicate for which student populations—all students, women, minorities—the institutional effects were significant. For the purpose of these tables, major refers to the specific area of study that students were enrolled in when asked four years after college entry. Career represents the anticipated career plans of the student. Students who were recruited began college with majors in non-science fields, but indicated that they were science majors four years later. Persistence refers to students who maintained their interest in science majors from the time they entered college until four years later. Finally, hard science careers include engineering, research scientist, statistician, conservationist or forester, and college teachers with final majors in Biological Science, Physical Science, or Engineering.

Table 10.1
Outcomes for Johns Hopkins University

Science outcome	Positive influence for:
Majors	
Biological sciences	All students
Engineering	All students Women
Career	
Engineer	Women
Engineer or Scientist (Natural)	Women
Engineer or Scientist (Natural, Social, or Clinical)	All students Women
Recruitment	
Hard science career	All students Women

Table 10.2
Outcomes for Case Western Reserve University

Science outcome	Positive influence for:
Majors	
Physical sciences	Women
Engineering	Minorities
Career	
Engineer	Minorities
Engineer or Scientist (Natural, Social, or Clinical)	Minorities
Persistence	
Hard science career	Women

Table 10.3
Outcomes for Albion College

Science outcome	Positive influence for:
Majors	
Biological sciences	All students
Career	
Engineer or Scientist (Natural, Social, or Clinical)	All students

Table 10.4
Outcomes for Santa Clara University

Science outcome	Positive influence for:
Majors	
Physical sciences	Minorities
Career	
Engineer or Scientist (Natural, Social, or Clinical)	All students
Recruitment	
Hard science career	All students

Table 10.5
Outcomes for Georgia Institute of Technology

Science outcome	Positive influence for:
Majors	
Engineering	All students Women Minorities
Career	
Engineer	All students Minorities
Engineer or Scientist (Natural)	All students Minorities
Engineer or Scientist (Natural, Social, or Clinical)	All students Women Minorities
Persistence	
Hard science career	All students
Recruitment	
Hard science career	All students Women Minorities

Campus Descriptions

As indicated, the five site visit institutions represented a variety of college and university types and size. Student enrollments for each institution are listed in Table 10.6.

Johns Hopkins University

Although Johns Hopkins is located just two miles from downtown Baltimore, it is situated in a residential setting. Many of the faculty live in an affluent area near campus, while students are required to live on campus during their first two years. Many upperclassmen choose to live in one of the many old brick rowhouses or the few large apartment buildings in the neighborhood. The student area surrounding JHU is a low-income community without a real center of town. Rather, there is a sprinkling of fast food restaurants and convenience stores.

The Johns Hopkins University was founded in 1876 by a Quaker merchant. The Homewood campus (main undergraduate campus) was originally the Homewood estate, built for Charles Carroll, Jr., son of the signer of the Declaration of Independence. The university was given the estate in 1902 and the Faculty of Philosophy began instruction on the campus in 1915.

Johns Hopkins is a privately endowed, research university with selective admission standards. It consists of four campuses. Homewood is the main campus and offers the School of Arts and Sciences and the G.W.C. Whiting School of Engineering. It consists of 140 acres of woodlands, and lush lawns bordered by cherry trees and magnolias. The architecture is primarily Georgian complemented by a few modern structures. Undergraduate science majors attend the vast majority of their classes at the Homewood campus.

The educational philosophy at Johns Hopkins was articulated over a century ago by the university's first president, Daniel Coit Gilman. He believed that the best type of education occurred in a research environment under the supervision of an active researcher. The belief in the interconnectedness of education and research has become a distinguishing feature of the university. In fact, in 1989 Johns Hopkins received over 430 million dollars of research monies from the federal government.

Another feature that makes undergraduate education at Hopkins a unique experience is the commitment to academic and organizational freedom. JHU believes that providing individuals with flexibility and independence gives them choices and responsibility that enhance learning and foster innovation.

Case Western Reserve University

Case Western Reserve University (CWRU) is an independent coeducational university in Cleveland, Ohio. The university was formed into its present configuration in 1967 by the federation of Case Institute of Technology (CIT)—an engineering and technical school—and since the early 1800's in other areas of Cleveland and had subsequently moved to where the university currently resides. After changing locations, the CIT and WRU campuses were adjacent yet independent. Physically, the two institutions were separated by a main street and a chain link fence.

In 1967, the two institutions merged to create Case Western Reserve University. Cooperative ventures between Case Institute of Technology and Western Reserve University actually began as early as 1887 with the Michelson-Moreley experiment which destroyed the ether theory of space. However, joint efforts intensified in the 1950s and 1960s. During this time period, the two schools adopted the same academic calendar, registration became interchangeable so that students could take classes at either institution, and the astronomy and geology departments became a single unit serving both institutions. Language instruction for both schools was taught at Western Reserve, and cooperation took place between programs in the Western Reserve School of Medicine and the Case Engineering Division, as well as between science departments in the two institutions. However, we were told that the impetus for the final merging of the two schools came from the National Science Foundation (NSF). Both institutions were seeking NSF funding; however, the Foundation felt it was impractical to grant major funding to similar projects at two institutions which were adjacent to each other. NSF indicated, however, that the funding would continue if the two institutions merged into one. Today, Case Western receives over 62 million dollars in federal funds for research.

Students at Case Western are enrolled in programs in engineering, science, management, nursing, the arts, humanities and the social and behavioral sciences. In addition, they have access to the facilities of a comprehensive university, including graduate and professional schools in applied social sciences, dentistry, humanities, the social and natural sciences, engineering, nursing, medicine, law, and management. CWRU is located in 'University Circle' which is considered a cultural extension of the campus. The Cleveland Museum of Art, the Cleveland Museum of Natural History, and Severance Hall, home of the Cleveland Orchestra, are within walking distance of the campus.

Although Case Institute of Technology and Western Reserve University merged over 25 years ago, there remains a division between what used to be the two campuses. This division occurs between science and non-science students (commonly called 'reservies'). Geographically and curricularly, there is a separation between these two groups of students. The science departments and engineering school are housed on the south side of campus, while the social sciences and humanities departments are on the north side of campus. North and south campuses are not only separated by a major street, but the north campus buildings face north, while the south campus buildings face east, west or south. In other words, the fronts of most buildings on either side of campus back-up to one another, rather than face each other. Further separation results from the location of the residence halls. Students who are science and engineering majors live on the south side of campus, while non-science students live on the north side of campus. As a result of this geographic delineation between departments, classrooms, and residence halls, there are limited opportunities for peer interaction among the science and non-science student populations. Given the peer group effects noted in Chapter 3, this physical segregation of the science students may explain at least some of the positive effects of this institution noted in Table 10.2.

Albion College

Founded more than 150 years ago, Albion College is an independent, coeducational, residential college. The school is dedicated to preserving the values of the past, to serving the needs of the present and to anticipating the goals of the future. The college is located in the city of Albion which is a community of about 11,000. The city was founded in the 1830s along the banks of the Kalamazoo River. The college is located 90 miles west of Detroit and 175 miles east of Chicago. Albion's 30 major buildings sit on 215 acres of land. The college is historically related to the United Methodist Church and as a result is connected with Judeo-Christian thought and values. The institution takes pride in the fact that 95 percent of the faculty have PhD's, and that teaching is given primary emphasis. Unlike the four other schools in our case study sample, Albion receives no federal monies, as recorded by the National Science Foundation, for research.

Albion places great emphasis on preparation for careers and on preparing students for graduate and professional studies. The admissions catalog includes a career directory which provides students with suggestions on how to prepare for careers in over 60 fields. Albion produces many science graduates, often as many as the University of Michigan and Michigan State University—both schools with much larger science programs. The pre-medical and pre-dental programs are especially popular, perhaps because of the high acceptance rate of Albion graduates into professional schools.

There are five science departments at Albion College: Biology, Chemistry, Geology, Physics, and Mathematics and Computer Science. Additionally, Albion offers 3–2 programs in engineering with the University of Michigan, Michigan Technological University, Washington University of St. Louis, Columbia University, and Case Western Reserve University. Through these programs, students spend three years at Albion, and two years at an engineering school. They then receive a BA from Albion, as well as a BS from the engineering school that they attend.

Santa Clara University

Founded in 1851, Santa Clara University is a Jesuit institution which is located in Santa Clara, California. The University is founded on the belief that values are informed by reason and that their ultimate goal is the education and growth of the whole person, not just the intellect. Santa Clara is a small city directly adjacent to San Jose in the Silicon Valley of northern California. The campus is located on 103 acres of land.

Santa Clara University has three undergraduate schools—the College of Arts and Sciences, the Leavey School of Business and Administration, and the School of Engineering. Students are not expected to know their major upon application to Santa Clara, but they must choose a particular school in which to apply. Santa Clara is a liberal arts institution that believes that all undergraduates form the foundation of their studies with a Core Curriculum. This curriculum includes courses in English, Western Culture, Foreign Language, Social and Natural Sciences and

Religious studies. Graduate programs in the sciences are not offered at Santa Clara; however, there are graduate programs in Engineering.

Georgia Institute of Technology

Georgia Institute of Technology is located just minutes from downtown Atlanta, Georgia. Founded in 1888, the school prides itself in its commitment to research and to a student oriented philosophy. Georgia Tech is a public research institution. The students at Georgia Tech come from throughout the United States, as well as from other countries. Georgia Tech is often said to be the "Cal Tech of the South." Tech is just blocks away from one of the poorest housing projects in Atlanta. Thus, Georgia Techians refer to themselves as attending an "Urban University."

There are five colleges at Georgia Tech—Architecture, Computing, Engineering, Management Policy and International Affairs, and the Sciences. Within these colleges, Tech offers 27 undergraduate degrees, 33 master's programs, and 25 doctoral programs. Georgia Tech only offers a bachelor's degree in science (BS), and prides itself on its reputation for graduating minority engineers. Tech is a highly selective institution and recruitment of talented students is a top priority. Georgia Tech also receives over 53 million dollars in federal monies for research contracts and grants.

Table 10.6
Student Enrollments

Institution	Total	% Women	% Minorities
Johns Hopkins	2,770	37	20
Case Western Reserve	2,550	32	24
Albion College	1,630	48	6
Santa Clara University	3,670	48	26
Georgia Institute of Technology	8,803	23	16

Of the five institutions, only Georgia Tech, Johns Hopkins, and Case Western have specific summer programs which are set up to orient minority students to the college experience. These programs expose students to the resources available on campus and teach effective study skills.

The Office of Minority Educational Development (OMED) at Georgia Tech offers a summer program called "Challenge." In this program, students are introduced to what it means to be a student at Georgia Tech, how to study effectively, and what resources are available on campus such as tutoring or counseling. Students who participate in the Challenge program are invited to participate in other OMED programs through their stay at Georgia Tech. However, schools also indicated that they have limited resources to focus on retention of minority students. Rather, most of the funding and resources go toward general student support services.

Programs which focus on recruitment of women and minorities to the sciences differ by campus. Faculty and administrators at Case Western indicate that most efforts go toward recruiting *anyone* to the sciences, specifically in fields like mathematics and physics, rather than focusing efforts on a particular group. Many of the faculty we met with (at all five institutions) expressed their concern with the small number of women in their classes, and the even smaller number of minority students. However, we were told of only a few specific ideas or programs to change this situation. The Chair of the Case Western mathematics department indicated that more role models were needed in order to attract women and minorities to the sciences. He continued to express frustration over his inability to hire those role models. This was not due to the lack of qualified applicants for faculty positions, but rather to the lack of funding available for new hires. Indeed, it is very discouraging to know that even elite, private institutions are experiencing such financial difficulties. Clearly, public institutions are in an even worse situation. However, the Engineering faculty at Georgia Tech are in the process of establishing new policies and programs which will directly effect minority recruitment and retention. At the present time, Georgia Tech has an outreach program where school representatives go to high schools throughout the country to recruit students (in particular minorities) to Georgia Tech. The Engineering faculty are also implementing a "Faculty Friends" program where incoming students will be assigned a faculty "buddy" who will assist in the transition to college.

General Campus Climate

Although each campus is unique in its mission and overarching campus climate, there was a common feature of all the institutions in regard to their science programs. At each of the five institutions we visited, there is a great deal of faculty-student interaction. Although most of the faculty emphasize self-motivation and initiative, they are willing to work with students both in and out of the classroom. Students at all five of the institutions we visited emphasized the high level of faculty-student interaction, and faculty support in their academic success.

Another common feature of the five institutions is that science students on these campuses are not considered stereotypically as "geeks" or "nerds." In fact, in some instances, the sciences are the dominant majors on campus. For example, at CWRU over 80 percent of entering students are in the sciences and engineering fields. Although many of these students change to liberal arts or humanities majors during the course of their college experience, even at exit over 70 percent of all CWRU students graduate with engineering or science majors. However, it is important to note that engineering students often comprise the majority of students we identify as "science and engineering majors." At Georgia Tech, Case Western Reserve, and Johns Hopkins, for example, the engineering departments are the largest departments on campus. Nevertheless, even on campuses such as Santa Clara and Albion, where the liberal arts and humanities programs have the majority of students, the science students are respected and not considered out-of-place. Further, most of the students we spoke with indicated that their desire to study science or engineering started while they were in middle or high school. Science or engineering was their major choice prior to entering college.

Three of the institutions we visited had graduate programs in the sciences. The campus climate at each of these institution evidenced little, if any, competition between undergraduate and graduate students for research opportunities and faculty attention. The students we spoke with felt that faculty valued undergraduates just as much, if not more, than graduate students. One physics student at CWRU described the lack of a hierarchical structure at his school. He said that CWRU was different from other universities in that graduate students were not the only students who had access to the faculty. Rather, undergraduates had the same opportunities as graduate students to interact with the faculty and participate in research.

Another common element of all five institutions was that faculty, not graduate students, taught most of the undergraduate courses, including introductory courses. In only a few instances were we told of graduate students teaching classes such as introductory math or science for non-science major.

Independence, perseverance and competition were common elements of the campus climate at all institutions. In general, students indicated that it took a lot of self-initiative and independence to succeed in the sciences. For example, students at Johns Hopkins indicated that the faculty and administration did not coddle them; rather, they felt they had to take initiative and learn "the ropes" on their own. In a sense, there is a "survival of the fittest" attitude which prevails at most institutions we visited. At Santa Clara, for example, students have to successfully pass difficult introductory science courses which are designed to "weed out" students who might not be able to make it through the tough curriculum in the major. However, there was also substantial evidence at Santa Clara of a supportive environment. In some departments, for example, faculty take a proactive approach to working with students who may be having difficulty with their coursework. Students were not left simply to "sink or swim," but rather encouraged to persist even in the face of early poor performance.

Competition was described in different ways on each campus, yet it existed at all institutions. In part, this competition is promoted by the grading system. With few exceptions, faculty in the sciences and engineering grade on a curve. Students tend to accept this grading method with no complaints. Partly as a result of this method of evaluation, students are forced to be competitive and become hesitant to share knowledge. In fact, some students explained to us that they tend to study in groups only after they have mastered the material themselves. It is not that the students are opposed to working together, rather they want to feel confident in their contributions to a study group. This "process" of studying seems to result from the emphasis placed on independence, as well as the competitive nature of these institutions. However, it is important to note that competition may have served to motivate students to succeed.

We were unable to discern whether this same study "process" also existed for women and minorities. Women and minorities at several of the institutions we visited indicated that they felt the need to "prove themselves" to the faculty and to other students. In fact, women at Santa Clara indicated that women are often patronized by the male faculty, and that they feel they have to work extra hard to prove themselves in the classroom. Interestingly, women at Georgia Tech indicated that competition was a way to push each other, and it provided incentive to do well. There appeared to be a relationship between how women, in particular, were treated and the major that the women were in. For example, women who were biology majors did not feel the same need to prove themselves as did women in fields such as physics or engineering. This may be due to the larger number of women who typically major in biology. At all five institutions, biology was the field comprising the most women.

It is important to note that there were some individual faculty members or departments that were experimenting with alternative grading methods that tend to decrease the overall sense of competition. For example, the Biology department at Albion College has developed a point system for grading where all students are able to attain the same number of points and receive all A's if in fact they all achieve at the highest level. The only competition which arises from this system is the competition one feels with him or herself.

Another prevailing element of the campus climate which was apparent at all of our case study institutions was the interest of the faculty in teaching. Teaching was not considered either a burden or a necessary evil. In fact, faculty in the research universities we visited were able to pursue their research interests without sacrificing their teaching responsibilities. In general, students at all five of the institutions emphasized the excellent teaching they were receiving. Interestingly, the tenure and reward systems at these research universities does not appear, on the surface, to be different from that of other universities where research is given top priority.

A final common thread which was seen at all five institutions we visited was the large number of premedical students. The majority of these students were biology majors. And, as noted earlier, most of the women in science at each institution—students as well as faculty—were concentrated in the biology department. Although the implications of this finding are unclear, it becomes apparent that the majority of biology majors in these institutions will not be pursuing PhDs in the sciences, and as a result will not be entering the faculty or research pipeline. Premedical students also tended to be highly competitive, given the competitive nature of medical school admissions. Students felt that they needed to compete at the undergraduate level in order to succeed in being admitted to their preferred medical school. One exception to this generalization was Albion College, where the biology department—and consequently the majority of pre-med students—was the least competitive department. Indeed, students viewed their education primarily as a cooperative experience. This notable exception to the rule demonstrates that premedical education does not necessarily have to be a highly competitive experience for the undergraduate.

In general, the faculty and students in the sciences and engineering appear to enjoy their fields of inquiry. Although science or engineering education is a difficult, demanding area of study, the students we met with appeared to be committed to the sciences and genuinely interested in their education. There is an intellectual excitement and enthusiasm that we witnessed on all five campuses. In short, science education at our five case study campuses appears to be a very positive experience for the undergraduate.

Student-Student Interaction

Interaction among students will be looked at from two perspectives: interaction among science students and interaction between science and non-science students. We attempted to meet with both science and non-science students at each institution; however, we were unable to arrange meetings with non-science students at Case Western Reserve, Santa Clara and Georgia Tech. As a result, the conclusions regarding non-science students at these institutions are based primarily on the comments of science students.

Interaction among Science Students

In general, students tended to interact primarily with other students in their major field. At each of the institutions we visited, there seemed to be a strong sense of "community" within each science major. In particular, this bond was apparent in the smaller majors such as physics and chemistry. For example, we met with a group of physics majors at CWRU who were all very enthusiastic about their college experience, and particularly with the physics department. In the larger majors such as biology and engineering, there appeared to be a different sense of community. Engineering students were divided up by subfield (i.e., mechanical, chemical, civil), while students in biology had no particular pattern of interaction. Since many, if not most, of the biology majors were premedical students, they focused a great deal on getting into medical school.

As mentioned earlier, students within the sciences tend to study together, but only after they feel they had mastered the material individually. For example, a female biomedical engineering major student at Johns Hopkins told us that the attitude of most students is "What do you have that I can get." Clearly this attitude promotes a sense of competition among classmates. Another reason why students may not have the incentive to study together is that assignments tend to be geared toward the individual. We were told of very few group projects or labs. Rather, students are responsible for individual problem sets or experiments. Indeed, the science curriculum at the institutions we visited did not promote a great deal of interactive studying. Nevertheless, science students tended to study at the same place in the libraries, interacted in classes, and socialized together when possible. One exception was at Georgia Tech, where several of the upper level engineering courses required group projects.

In general, students indicated that they had little time for socializing because the demands of their classes left no time for outside activities. Nevertheless, many students indicated that the tradeoff between the demands of a science major and a college social life was worth it because they truly enjoy science and believe that their dedication now would ultimately pay off. We did, however, talk to several students who were involved in non-science activities such as music. In fact, it is interesting to note that both Case Western Reserve and Johns Hopkins are located fact, it is interesting to note that both Case Western Reserve and Johns Hopkins are located adjacent to renown schools of music (the Cleveland Conservatory of Music and the Peabody Conservatory of Music, respectively). A number of science students at both universities take courses at these music schools.

Science students interact with each other on both the academic and social levels, but this interaction takes place primarily within the major. Nevertheless, in all of the institutions we visited, science students are required to take science courses outside of their major and as a result, are able to meet science students in different fields. Faculty research projects sometimes provide a medium for interaction across different science majors. For example, since there are fewer research opportunities for students in engineering because of the applied nature of the field, engineering students often look for research opportunities in basic science fields.

Interaction between Science and Non-Science Students

In general, there was minimal interaction between science and non-science students at all of the institutions we visited. One obvious explanation for this finding is limited opportunities: between required courses and laboratory time, science students take few classes outside of the sciences. Further, there seems to be a pattern where science students take different science and non-science courses from those taken by non-science students. In other words, even when science students are taking general education courses outside their field, they tend to take the same courses as do other science students. As a result of this curricular segregation, most of the interaction between science and non-science students takes place in the dormitories or in extracurricular activities such as sports, fraternities or sororities, and other campus clubs and organizations.

Faculty-Student Interaction

Faculty-student interaction was both frequent and generally positive at the institutions we visited. Many students stated that they were attracted to their schools because of the good reputation of the faculty, the opportunity to conduct research with faculty, the faculty commitment to teaching, and the low faculty–student ratio. Students feel that their faculty are approachable, interested in student academic success, and enthusiastic about their field. Many students said that they wanted to do well in order not to disappoint particular faculty members who had taken a personal interest in their success. However, students also recognize that in order to develop a relationship with faculty, they need to take the initiative and express an interest in the faculty's research. Further, they feel that they have to "prove" themselves intellectually and to "knock on doors" rather than wait for the faculty to approach them.

In general, faculty at our case study institutions had positive impressions of the abilities and potential of their students. Some exceptions did occur with specific faculty at Santa Clara and Case Western. However, most faculty frequently cited the high SAT scores of the incoming classes and boasted about the graduate schools to which their alumni were accepted. Many professors stated that the science students had to work much harder than the non-science students because science courses were much more rigorous and required many hours in the lab. They also indicated that they respected their students and had high expectations of them. These attitudes may well have contributed to students' high expectations for themselves and their high level of persistence. Many of the professors told us that they enjoyed interacting with the students and had an "open door" policy which allowed students to meet with professors whenever the professors were in their offices.

Exceptions to the positive student-faculty interactions were more likely to be expressed by women and minorities. Women and minorities tend to feel that they have to "prove" themselves much more than do their white male peers. However, minority engineering students at Georgia Tech explained that they receive a great deal of attention from the faculty. In fact, it was primarily the white males at Georgia Tech who felt alienated from the engineering faculty.

Further, many women and minorities felt that because of their small numbers they were much more likely to be noticed for their successes as well as for their failures. This perception tended to put a great deal of pressure on them to perform. Other negative experiences with faculty included patronizing remarks that implied a student was unable to understand course material because of their race or gender, or suggestions that the student change to a less rigorous (i.e., non-science) major if they were experiencing difficulty with a course. One woman stated that a male professor "acted as if he didn't know what to do with women in his class." Some women and minorities were also likely to state that the lack of women and minority faculty made them feel unwelcome in class. However, others said that the lack of women and minority faculty made them want to stay in science in order to become a professor. These students indicated the need to change the underrepresentation of women and minorities in the sciences and they wanted to contribute personally toward making that change.

As already suggested, biology tended to be the most hospitable major for women. This may have to do with the large number of women in biology, as well as the presence of at least a few women on biology faculties. In addition, the age of the faculty as well as the age of the department seemed to influence levels of hospitality for women and minorities. The younger the faculty and the newer the department, the more hospitable the major tended to be.

Some faculty complained that students were not as well prepared as they were 10–20 years ago. They also felt that students didn't have the same curiosity to learn as they used to and that they typically just wanted to know what was going to be on the test. One chemistry professor at Albion explained that "A lot of our students are of the immediate generation, where there's instant gratification...and not very much put in to get an end result. And they somehow think that their education should be the same way. They don't want to do the long, organized problem to finally get some good answers."

None of the faculty mentioned that there was a problem for women or minorities in the classroom. They attributed the lack of women and minorities in science to inadequate preparation in middle and high school and little if any retention efforts on the part of the university. Some professors indicated that the lack of role model women and minorities may also be a contributing factor to the lack of women and minorities in the field.

Research Opportunities

At Case Western Reserve, Johns Hopkins, and Georgia Tech, the majority of students participated in research with faculty or graduate students. However, there were limited research opportunities available to students at Albion and Santa Clara. At the research universities, students worked for pay, for course credit, or as volunteers. The remuneration depended upon the funding that was available to the faculty member. Funding came from internal sources, fellowships or corporate sponsorships. Faculty frequently stated that since funding was limited, they could only choose the "best and brightest" students to work on research projects. However, they were also open to students who showed initiative and approached them for work.

Students frequently stated that working with faculty on a research project was one of the main attractions of a research university. Students who had worked on a faculty research project stated that it had a great impact on their academic experience because it gave them an opportunity to apply what they had learned in class and in lab to "real research." It also gave them close contact with a faculty member to discuss issues related to science, career and graduate school. Other students told us that additional benefits of working on faculty research were strong letters of recommendation and authorship on published research articles.

Advising and Student Services

Unlike many large research universities, where faculty do not advise lower division students, all of the institutions we visited assigned faculty advisors to their students. The main responsibility of these faculty advisors is to help students with academic decisions such as which classes to take, in what order, in what combination, etc. However, many faculty and students stated that the interactions typically only amounted to having faculty sign a study list a few times a year. This occurred, in part, because many students sought advice from faculty other than their appointed advisor.

Other students indicated that they received advice from the central student advising service that was available to the entire school. The central student advising service differed from campus to campus. Some institutions had advising services within each college (i.e., College of the Arts, School of Engineering); others had centralized services which were available to all students, regardless of major. Programs that were offered by these student service offices ranged from peer tutoring to emotional support groups. Some of the services were free of charge while others charged a minimal fee. The fact that the students we spoke with used student services only infrequently may reflect a selection bias. Typically these students, who were hand-picked by our administrative contact at the school, were high achievers. It is interesting to note, however, that some institutions did not seem to place a high priority on student services, as reflected in limited resources and even by the location of the student services offices. For example, the student support services at Case Western are located in a basement, where all offices are below ground and have a bleak look to them. Another example is at Johns Hopkins, where a search of a new director of minority student services has been going on for over a year. In the meantime, the minority students are not able to access some of the programs they may benefit from.

As discussed earlier, recruitment efforts vary from institution to institution. Many of the campuses, such as Georgia Tech and Case Western, have outreach programs for underrepresented groups. These programs typically focus on middle and high school age students who are invited for summer programs where they can learn study skills and also attend or observe classes and labs.

Several schools stated that their retention efforts are much weaker than their recruitment efforts. Retention efforts for all students include such practices as tutoring by graduate students or upperclassmen, developing academic skills, and providing mentors or peer advisors. An African American student at Johns Hopkins explained the peer mentoring program for incoming Black students which was established by the Black student organization. As a freshman, each African American student is paired with an upperclass person who serves as a role model and source of information for the new student. While this program has had its problems, it appears to facilitate retention of minority students. Other retention efforts by student organizations include informal study groups, mentee-mentor programs and programs to facilitate the emotional adjustment to college.

Additional efforts to encourage students to stay in the sciences have been sponsored by departments and individual faculty. These programs include department socials, dinners at faculty's homes, mentee-mentor programs, and outings with professors (one professor at Johns Hopkins is known for taking students to Baltimore Orioles games each year, while a professor at Georgia Tech takes his students on "environmental" field trips). Although some of these programs were not developed with the specific intent of improving student retention, they serve to connect the student with the institution, department, and faculty.

Pedagogy

All five case study campuses evidenced a strong commitment to teaching. Having professors rather than graduate teaching assistants teach basic courses is perhaps the best indication that the faculty and the institution value undergraduates and teaching. In fact, at some of the institutions tenure and promotion was based mainly on excellent teaching. In spite of this commitment to teaching, very few innovative teaching practices were employed. The vast majority of the courses at the institutions we observed were taught in a traditional lecture style. The professors typically stood at the front of the room often behind a table or lectern and used a chalk board or overhead projector to illustrate a concept or to write out a formula. Although all of the professors we observed had PhD's and were considered experts in their fields, few seemed able to present their knowledge in an interesting or provocative way. Many professors mumbled, avoided eye contact by looking at the floor, and asked rhetorical questions that they quickly answered themselves. The "energy" was very low in such classes. Many students arrived late and many left early. Students slept, ate, read the newspaper, or even talked to each other. In essence, students were not engaged in the learning process. Some students expressed disappointment with the "boring" lectures of certain faculty who taught the same courses year after year. A physicist at Santa Clara, however, defended the traditional lecture method: "You get it alone by thinking hard...That's what I had to do...That's what they're going to do!" Nevertheless, most students seemed to accept traditional teaching methods. We believe that this acquiescence occurred in part because of their lack of exposure to any other teaching style. Students are typically lectured to in high school and expect similar treatment in college. Clearly, the science faculty meet the students' expectations.

Students appeared to be much more engaged in the learning process (e.g., took notes, leaned forward, laughed, enjoyed the class, asked questions during and after class) in classes where professors showed enthusiasm, gave demonstrations, or simply moved around the classroom. One exceptional professor taught an organic chemistry course with several hundred students. His lecture was easy to follow; he spoke clearly and faced the class when he was not writing on the board. He periodically asked if there were any questions and paused to look around the room for students with raised hands. This professor brought the course material to a relevant or tangible level by relating it to history, or by demonstrating how the formula or molecular structure was used by living organisms, or by industry. For example, the professor explained that a certain molecular structure was found in many natural fibers such as cotton. He went on to explain that during the Civil War the military used guncotton as an explosive because it ignited easily and didn't leave any smoke or ash. The lack of smoke allowed soldiers on the battlefield to see their enemies. He then demonstrated this by igniting guncotton which went up in a flash without any smoke or ash. The entire class cheered at this demonstration. The professor also discussed the connection between science and industry by showing how celluloid was used in early motion picture film and records. To illustrate this point he brought in an old phonograph record player and played records from the turn of the century.

Another exceptional professor was a participant in a Lilly Teaching Fellows Program funded by a grant from the Lilly Foundation. As a Lilly Fellow, the professor had attended several conferences and workshops on alternative teaching styles and had implemented these styles in the classroom. Additionally, he and other Lilly Fellows at Case Western meet regularly as a group to discuss pedagogy and other issues related to teaching. Each program participant also works closely with a mentor at CWRU. This mentor is expected to provide on-going feedback and guidance to the Lilly Fellow.

The particular professor we observed was teaching a physics course at CWRU which traditionally had been taught in a lecture style using problem sets as homework and as a guide through the material. For the first time, the course had group projects which took the place of the problem sets. Further, students were encouraged to interact in the classroom. For example, during the session we observed, the professor was explaining a problem which seemed to be particularly confusing. In the middle of his explanation he stopped, turned to the class and asked students to form small groups in order to discuss the confusing aspects of the problem. The students proceeded to assemble into small groups and talked about the problem for the next 5–10 minutes. The class then regrouped and reviewed the solutions which arose from the small group discussions. This technique appeared to be quite effective and stimulating for the students. It is interesting to note, however, that we were privy to a discussion at the beginning of the class regarding whether or not there should be the "traditional" final exam. The students felt that they had done more work during the course with the several group projects than in previous years and the professor agreed. However, the professor was hesitant to give up the traditional exam. He felt that the final exam was necessary to prove to his colleagues (and possibly himself) that the non-traditional teaching styles he had employed were successful. So although he had been willing to change tradition in regard to teaching, he was hesitant to alter his mode of evaluation.

Another innovative teaching style—team teaching—has been employed at Albion College for over ten years. Team teaching, which occurs within each major as well as between science departments (i.e., math and physics, geology and biology), allows students to understand science across disciplines and promotes interaction between students with different science majors.

Some faculty complained that students were more interested in fast-paced learning (more demonstrations, visuals, quick answers, etc.) instead of developing analytical skills and working out long problems that take lot of time. However, both students and faculty recognized that being able to provide quick responses to questions and having experience taking multiple choice exams help them prepare for MCAT's and GRE's. And, as already noted, many faculty stated that students were mainly interested in learning what would be on the exam rather than in developing their natural curiosity to learn. In one class we observed, the professor asked if there were any questions concerning the content of the lecture, and a student raised his hand and asked, "When's the exam?"

With the exception of Albion, there were no efforts by faculty to incorporate contributions by women and minorities in science into the curriculum. Albion has recently offered a course entitled "Women and Minorities in Science," which looks at the history and contributions of women and ethnic minorities to the science fields. Most faculty, however, believe that gender and race are not issues that need to be addressed and that all students are treated the same in their classes regardless of race or gender. Some administrators, however, stated that their institution did not have a "good track record with women" in the sciences or that their institution was "unfriendly to minorities." However, this sentiment was not held by the majority of administrators.

Summary

Our observations from the five site visits have served to enhance our understanding of factors which contribute positively to the experience of students in the sciences and engineering. We believe that these five institutions exemplify certain practices that other institutions can emulate to increase their retention and recruitment of science students. Specifically, these common elements include: an emphasis on teaching, research opportunities for undergraduates, high levels of faculty-student interaction, a supportive campus climate, and a high priority placed on undergraduate education.

An Emphasis on Teaching

Probably the most significant feature shared by all five of the case study institutions we visited is their emphasis on teaching. Even at prestigious research universities such as Johns Hopkins and Case Western Reserve, senior faculty regularly teach most undergraduate courses. Many of the students say that they were encouraged and inspired by taking introductory courses from faculty whose research was world-renown. Teaching is highly valued at these institutions and not seen by the faculty as a burden.

A High Level of Faculty-Student Interaction

The involvement of faculty with students both inside and outside the classroom was apparent at all of the institutions we visited. Faculty-student interaction takes place in the form of research opportunities, social situations, and intellectual conversation. Faculty encourage students to come to their offices and discuss issues face-to-face. Most of the students we spoke to felt very comfortable approaching their professors for advice, jobs, and letters of recommendation. Further, since the ratio of faculty to students is favorable at all of the site visit institutions, students are not competing with each other for faculty attention.

A Campus Climate Which is Supportive of the Science Student

Science students feel welcome and at home on all five campuses. We often think of science students as being introverted or anti-social; however, this was not the case with most of the students with whom we met. Science and engineering majors on campus are well respected and although non-science students would not want to "switch places" with their science classmates, they respect and admire the commitment of the science students. In short, the dominant campus climates at the institutions we visited were supportive to science and engineering students.

A High Value Placed on Undergraduate Education

A common feature of all site visit campuses is the high priority that each institution assigns to undergraduate education. Even in the research universities, where graduate education is often the focus, undergraduates are considered the most important institutional clients. This priority is reflected by the fact that virtually none of the science or engineering departments uses graduate students to teach undergraduate courses. Undergraduates are also given as many opportunities for research experience as are the graduate students. There does not appear to be the typical hierarchy —faculty – graduate students – undergraduates—which exists at most research universities.

Final Thoughts

Along with the themes addressed above, there are a few other case study findings which are important to note. First, while innovative teaching methods seem to be well received by students in the sciences, science faculty remain hesitant to alter their traditional pedagogical styles. Second, peer interaction in the sciences reflects the highly competitive nature of the field. In a sense, the nature of interaction among science students reflects the socialization that occurs within each major—socialization which emphasizes independence, achievement, and self-initiative. Nevertheless, students at the institutions we visited seem to have good rapport with each other and, in general, seem to enjoy their experience with science education.

CHAPTER 11

Minority Science Programs

Much has been written about aspects of the college environment which deter minorities from pursuing careers in science, but not much is known about programs designed to help retain these students. The purposes of this chapter are: (1) to describe several exemplary minority science programs; (2) to identify the types of institutions which are likely to participate in these programs; and (3) to estimate the impact these programs have on science outcomes for minority students.

Table 11.1 lists some of the major federally–funded minority science programs. For the present study, we were able to collect information on four of these undergraduate science programs: two NIH–sponsored programs—the Minority Access to Research Careers (MARC) program and the Minority Biomedical Research Support (MBRS) program—and two minority engineering programs—the Minority Engineering Program for Undergraduates (MEPU) and the Minority Engineering Precollege Program (MEPP). We begin by taking a descriptive look at these programs. We will then examine the types of institutions in our database that are likely to have these programs. Finally, we will evaluate the impact of these programs on student outcomes using our longitudinal student data base.

Table 11.1
Undergraduate Science Programs for Minorities

Program Name	Type of funding	Types of colleges	Target population	Time/Amount of funding
Minority Engineering Program	Private and Institutional level funding	Public and Private four year institutions and community colleges	African American, Chicano, and American Indian undergraduate engineering majors	Program initiated by private grants and maintained by institution for an indefinite period
Mathematics, Engineering & Science Achievement Program	Private and Institutional level funding	Public and Private four year institutions	African American, Chicano, and American Indian undergraduate engineering majors	Program initiated by private grants and maintained by institution for an indefinite period
Program for Achievement in Computing and Engineering	Private and Institutional level funding	Public and Private four year institutions	African American, Chicano, and American Indian undergraduate engineering majors	Program initiated by private grants and maintained by institution for an indefinite period
Minority Engineering Advancement Program	Private and Institutional level funding	Public and Private four year institutions	African American, Chicano, and American Indian undergraduate engineering majors	Program initiated by private grants and maintained by institution for an indefinite period
Minority Biomedical Research Support	National Institute of Health (NIH)	Predominantly Minority Institutions	Minority undergraduates/minority graduates	NIH sponsors students to work with faculty for a salary.
Minority Access to Research Careers	NIH	Public and Private four year institutions	Minority undergraduate honors students/Young minority faculty	$4.9 Million in 1984 NIH sponsors stipends for undergraduate research study
Howard Hughes Medical Institute Undergraduate Biological Sciences Education Initiative	Private foundation	Public and Private 4 year institutions	Undergraduate students in the biological sciences especially women and underrepresented groups	Two-year funding between $1 and $2 million to be used by institutions over a five year period

Description of Four Major Programs

The National Institutes of Health (NIH) sponsors two programs geared toward increasing the number of underrepresented minorities pursuing careers in the biomedical fields: MARC and MBRS. These programs are targeted toward institutions with predominantly minority populations (Stefano & Leung, 1986). Both programs award grants to support research which will result in the exposure of upper division undergraduate students to the research experience. What follows is a description of each program.

The MARC program was established in 1975 by the National Institutes of Health (Collea, 1990) to help increase the number of minorities in biomedical careers. In order to qualify for MARC, students must have a freshman grade point average of 3.2 (Stefano & Leung, 1986). The main program under MARC is the Undergraduate Research Training Grant, an honors program designed to encourage undergraduate students to engage in independent study under the supervision of a faculty advisor. Many students participating in MARC have been successfully placed into graduate programs. Schools which participate in the MARC program report an increase in the number of minorities graduating with bachelor's degrees in biological science since the program's inception (Collea, 1990).

The Minority Biomedical Research Support (MBRS) program is also sponsored by NIH . It is different from the MARC program in that it is not an honors program. MBRS is a research program which employs undergraduates and graduates to work with faculty members as research assistants. Institutions wishing to participate in MBRS must submit a formal research grant proposal to the NIH. Upon funding of the research, principal investigators must then employ minority undergraduates and graduate students to work as research assistants (Stefano & Leung, 1980). NIH also provides funds for students to travel to conferences to present their work and sponsors a conference once a year for students to share their experiences with one another.

In 1974, efforts were launched by the National Academy of Engineering (NAE) to increase the representation of minorities in Engineering. As a result, the Committee on Minorities in Engineering (established by the NAE), with the help of the National Advisory Council on

Minorities in Engineering (NACME), established the first Minority Engineering Programs (Collea, 1990). These programs are designed to facilitate the enrollment and retention of minority groups which have been historically underrepresented in Engineering. These groups specifically include African Americans, Mexican Americans, Puerto Rican Americans, and American Indians (NACME, 1986). There are two types of Minority Engineering Programs: those targeted at freshmen undergraduates and those targeted for high school and precollege students. It is generally agreed that MEP has contributed significantly to the increase in minority enrollments in engineering programs that has occurred since the mid-1970s.

Institutions participating in the program use the funding in different ways. Most programs have support services (such as tutorials and career information), intervention programs, and mentoring. Since MEP is institutionally based, each program is unique in certain respects. These differences, in turn, appear to produce different outcomes. For example, a study conducted by Fisher (1984) contrasted two different precollege engineering programs. One program took students on site to a corporation so that they could have first hand experience of what real engineers do. Another program took students to a college campus to allow them to participate in actual engineering courses. Fisher found that, although students in both programs did better academically than students who were in no program at all, students in the work experience group performed even better than did the students in the college classroom group (Fisher, 1984). The minority engineering program in California, in particular, has had exemplary results. In 1988, there were over 2,000 students enrolled in MEP programs (Collea, 1990). Through these programs, the state has been able to retain a substantial number of its minority engineering students.

Where are Minority Science Programs Available?

In order to evaluate the impact of minority science programs, we identified those institutions in our sample that actually participate in these four programs. This section presents descriptive data about these institutions. The next section assesses their impact on the participants.

Table 11.2 shows the science programs by institutional type. The reader should be reminded that the percentage given is not based on the number of institutions in our sample but on the number of students in our sample who attend those particular institutions. Black institutions are much more likely to participate in MARC and MBRS than they are to participate in MEPU and MEPP. Of the students at black institutions, 36.1% are at institutions with MARC and 85.3% at schools with MBRS. This is compared to the students at white institutions: 1.4% are at institutions with MARC and 2.1% are at schools with MBRS. However, black institutions in our sample are barely represented (if at all) among the Minority Engineering Programs. Of the students at white institutions, 16.8% are at schools with MEPU and 9.6% for MEPU. Yet, there are no black institutions in our sample with MEPU and just a fraction of the students at black institutions (0.4%) attend institutions with MEPP. This may well reflect the absence of engineering programs at the black institutions in our sample.

Table 11.2
Minority science programs by race of institution

		% of students at institutions which have:			
Institutional race	N	MARC	MBRS	MEPU	MEPP
White	25,816	1.4	2.1	16.8	9.6
Black	490	31.6	85.3	0.0	0.4

The results no doubt reflect the fact that the MARC and MBRS programs are targeted toward institutions with predominantly minority populations. It should also be noted that the majority of the black institutions in our sample are private 4-year colleges and that Minority Engineering Programs are funded by the state. Nearly half (47%) of African American students in our sample attend predominantly black institutions.

Table 11.3 looks at differences by institutional control. Of the students at private institutions, 7.4% go to institutions with MEPU and 4.9% go to institutions with MEPP (see Table 11.3). However, students at public institutions are much more likely to have access to Minority Engineering Programs (29.1 and 15.6 percent).

Table 11.3
Minority science programs by institutional control

Institutional control	N	% of students at institutions which have: MARC	MBRS	MEPU	MEPP
Public	11,084	3.6	5.2	29.1	15.6
Private	15,222	0.9	2.5	7.3	4.9

Institutional level correlations

Table 11.4 shows zero-order correlations of these programs (scored as dummy variables) with selected institutional level variables. Only those variables with significant positive correlations of .20 or higher with any one of our four programs were included in the table. Several aspects of the college environment are moderately related to an institution's likelihood of having these programs. Looking at the correlation matrix, we find that the two NIH programs tend to fall out together, as do the two minority engineering programs. This may be because each of these programs is oriented toward particular types of institutions. Indeed, only a handful of the institutions in our sample participate in both the Minority Engineering Program and precollege program. Moreover, these programs are funded by completely different agencies and thus targeted at completely different types of institutions. As was mentioned earlier, the NIH programs are targeted primarily at institutions which have predominantly minority populations whereas the minority engineering programs are supported by the state and limited by definition to those public institutions that offer engineering programs.

Institutions with the MARC and MBRS programs are likely to use written feedback rather than grades and to have environments in which the mean political orientation among students tends to be liberal, where faculty tend to be involved in administration, and where a high percentage of the student body is majoring in the biological sciences. Further, both the students and the faculty tend to be committed to social activism. And as already noted, these programs are highly likely to be found in black institutions.

Institutions in which the student population has high intellectual self-esteem and a strong scientific orientation are most likely to participate in the MEP programs. Participation in these programs is also moderately correlated with several variables which are indicative of a focus on

Table 11.4

Zero order correlations with selected institutional level variables

	MARC	MBRS	MEPU	MEPP
Written Evaluation	**37**	**26**	-11	-08
Mean political orientation	**20**	**21**	05	-06
Faculty involvement in administration	**20**	**23**	-03	-14
Percent students majoring in biological science	**20**	**19**	00	03
Institutional race: Black	**33**	**60**	-06	-04
Faculty percept: Keen competition among students	**-29**	**-24**	**22**	**21**
Peer mean/social activism	**23**	**35**	**-20**	**-16**
Faculty percept: commitment to social activism	**15**	**25**	**-38**	**-35**
Progressive Offerings	07	01	**37**	**29**
Status of minority/third world studies	15	07	**40**	**24**
Status of women/gender studies	13	03	**37**	**27**
Peer mean/Intellectual self-esteem	-01	-02	**23**	**24**
Peer mean/scientific orientation	17	17	**25**	**26**
Percent science faculty	06	05	**21**	**28**
Percent faculty with PhDs	04	-04	**24**	**17**
Worked with students on research	03	02	**48**	**26**
Use of graduate teaching assistants	15	08	**58**	**36**
Faculty morale	07	-04	**26**	**15**
Research orientation	03	-02	**47**	**36**
Faculty percept: resource and reputation emphasis	-03	-03	**40**	**37**
Faculty percept: racial conflict	03	-11	**40**	**15**
Percent students majoring in engineering	-66	-04	**34**	**32**
Public university	13	12	**39**	**24**
Private University	-07	-10	**02**	**06**
Total Enrollment	02	00	**44**	**24**
Percent graduate students	-09	-16	**39**	**35**
Percent Asian students	07	00	**33**	**17**
Student/faculty ratio	02	-02	**36**	**20**
Percent of students majoring in scientific fields	01	05	**32**	**28**
Average faculty salary	00	-11	**51**	**35**
Enrollment size	-04	-06	**58**	**28**

Notes: Numbers in bold denote high correlations with the outcomes. Decimals have been omitted from coefficients.

science and research: the percentages of science faculty and of faculty with PhDs, the percentage of graduate students, the percentage of bachelor's degrees awarded in scientific fields, and the percentage of Asian students. MEP programs are most likely to be found at large, public universities that pay their faculties well and that put a strong emphasis on research.

Impact on student outcomes

In order to understand what impact these programs may be having on the students, institutional participation in these programs was included as four additional independent (dummy) variables in all regression analyses reported in Chapters 3, 4, and 5. Of the 72 opportunities for these variables to enter this regression (4 variables x 18 regressions), only one did: the MBRS program has a positive effect on persistence in a biological science program. Next, the analyses in Chapter 3 were repeated using only those students who would have been eligible to participate (African-American, Latinos, and American Indians), but none of these analyses produced a significant effect. An inspection of the step-by-step results shows that, after controlling for student input characteristics but before controlling for college environmental variables, at least one of the programs carries a significant weight. After controlling for aspects of the college environment (such as the peer and faculty environment), however, the weights are reduced to nonsignificance. One problem with these analyses is that we had no student level data showing who actually participated in these programs. If the actual rate of student participants is very low, then the amount of error generated by the nonparticipants at those institutions offering these programs may overwhelm any programs effect. What this analysis has shown is that, at the institutional level, participation in these programs is related to a number of other variables that reflect an institutional commitment to student success in science. Controlling for these other correlated variables thus eliminates any program "effect." Even though we produced no evidence of a direct effect of these programs the limited number of evaluations that have been done by others indicate positive effects at the student level. For example, the State University of New York (Westerbury) reports success with its MARC program in enabling undergraduate participants to gain access to research experience as well as the opportunity to publish original work (Stefano & Leung, 1986). One of the factors that contributes to the success of students who participate in the minority engineering program is the supportive environment created by the "clustering" of students who participate in the programs (Collea, 1990).

Summary and conclusions

In this chapter we have examined the impact on students' choices of science majors and careers of four minority science programs: the Minority Access to Research Careers program (MARC), the Minority Biomedical Research Support program (MBRS), the Minority Engineering Precollege Program (MEPP), and the Minority Engineering Program (MEP) for Undergraduates. MARC and MBRS are most likely to be found at predominantly black institutions, whereas the minority engineering programs are more likely to be located in large public institutions. This difference is attributable in part to funding differences: NIH, which funds MARC and MBRS, has targeted primarily minority institutions, whereas the MEP programs, which are funded by the states, largely targets public 4-year institutions.

Regression analyses showed virtually no significant effects of institutional participation in one of these programs on students' choices of science majors or careers. The only significant effect—which may well be a chance finding, given the large number of analyses conducted—is the positive impact of having an MBRS program on student persistence in the biological sciences. It is important to realize, however, that since the available data precluded any assessment of program impact at the level of individual student participant, any final conclusions concerning the impact of these programs on the student's choice of science majors and careers will require information on which students actually participate.

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Appendix A

Survey Instruments

1985

FRESHMAN

SURVEY

274035

PLEASE PRINT: YOUR NAME ______________________
First Middle or Maiden Last

HOME STREET ADDRESS ______________________

CITY STATE ZIP CODE ( ) Area Code Home Phone No.

When were you born?

Month (01-12) Day (01-31) Year

1985 STUDENT INFORMATION FORM

DIRECTIONS

Your responses will be read by an optical mark reader. Your careful observance of these few simple rules will be most appreciated.

- Use only black lead pencil (No. 2 is ideal).
- Make heavy black marks that fill the circle.
- Erase cleanly any answer you wish to change.
- Make no stray markings of any kind.

EXAMPLE:

Will marks made with ballpoint or felt-tip marker be properly read? Yes . . ○ No . . ●

Dear Student:

The information in this form is being collected as part of a continuing study of higher education conducted jointly by the American Council on Education and the University of California at Los Angeles. Your voluntary participation in this research is being solicited in order to achieve a better understanding of how students are affected by their college experiences. Detailed information on the goals and design of this research program are furnished in research reports available from the Higher Education Research Institute at UCLA. Identifying information has been requested in order to make subsequent mail follow-up studies possible. Your response will be held in the strictest professional confidence.

PLEASE USE #2 PENCIL

Sincerely, Alexander W. Astin

Alexander W. Astin, Director
Higher Education Research Institute

MARK IN THIS AREA ONLY IF DIRECTED									GRP. CODE	
⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①	①	①	①	①	①
②	②	②	②	②	②	②	②	②	②	②
③	③	③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

1. Your sex: Male . . ○ Female . . ○

2. How old will you be on December 31 of this year? (Mark one)

16 or younger	○	21-24	○
17	○	25-29	○
18	○	30-39	○
19	○	40-54	○
20	○	55 or older	○

3. Are you a twin? (Mark one)

No . . . . ○ Yes, identical . . ○
Yes, fraternal . . ○

4. In what year did you graduate from high school? (Mark one)

1985	○	Did not graduate but passed G.E.D. test	○
1984	○		
1983	○	Never completed high school	○
1982 or earlier	○		

5. Are you enrolled (or enrolling) as a: (Mark one) Full-time student? . . . ○ Part-time student? . . . ○

(Note: Please check that your pencil markings are completely darkening the circles. Do not use pen or make ✓'s or X's. Thank you.)

6. Where did you get the money to pay for college this year? (Write in actual dollar amounts; write "0" if none)

Grants and scholarships	$
All loans	$
Work or savings	$
Parents and/or spouse	$
Other sources	$

7a. How many persons are currently dependent on your parents for support (include yourself and your parents, if applicable)?

1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 or more ○

7b. How many of these dependents other than yourself are currently attending college?

None ○ 1 ○ 2 ○ 3 or more ○

8. What was your average grade in high school? (Mark one)

A or A+ ○ B ○ C ○
A- ○ B- ○ D ○
B+ ○ C+ ○

9. Where did you rank academically in your high school graduating class? (Mark one)

Top 20% . . . . ○ Fourth 20% . . ○
Second 20% . . ○ Lowest 20% . . ○
Middle 20% . . ○

10. Are you: (Mark one)

Not presently married . . . . ○
Married, living with spouse . . . . ○
Married, not living with spouse . . . . ○

11. Prior to this term, have you ever taken courses for credit at this institution?

Yes . . . . ○ No . . . . ○

12. Since leaving high school, have you ever taken courses at any other institution? (Mark all that apply in each column)

	For Credit	Not for Credit
No	○	○
Yes, at a junior or comty. college	○	○
Yes, at a four-year college or university	○	○
Yes, at some other postsecondary school (For ex., technical, vocational, business)	○	○

13. What is the highest academic degree that you intend to obtain? (Mark one in each column)

	Highest Planned	Highest Planned at this college
None	○	○
Vocational certificate	○	○
Associate (A.A. or equivalent)	○	○
Bachelor's degree (BA, BS, etc.)	○	○
Master's degree (MA, MS, etc.)	○	○
Ph.D. or Ed.D.	○	○
M.D., D.O., D.D.S., or D.V.M.	○	○
LL.B., or J.D. (Law)	○	○
B.D. or M.DIV. (Divinity)	○	○
Other	○	○

14. Where do you plan to live during the fall term? If you had a choice, where would you have preferred to live? (Mark one in each column)

	Plan To Live	Prefer To Live
With parents or relatives	○	○
Other private home, apt. or rm.	○	○
College dormitory	○	○
Fraternity or sorority house	○	○
Other campus student housing	○	○
Other	○	○

15. Is this college your: (Mark one)

First choice? . . ○ Less than third choice? . . . . ○
Second choice? . ○
Third choice? . . ○

16. How many miles is this college from your permanent home? (Mark one)

5 or less ○ 11-50 ○ 101-500 ○
6-10 ○ 51-100 ○ More than 500 ○

17. To how many colleges other than this one did you apply for admission this year?

No other ○ 1. ○ 2. ○ 3. ○ 4. ○ 5 . . . . . ○ 6 or more . ○

Note: If you applied to no other college, skip to item 19 on the next page.

18. How many other acceptances did you receive this year? (Mark one)

None ○ 1. ○ 2. ○ 3. ○ 4. ○ 5 . . . . . ○ 6 or more . ○

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19. How much of your first year's educational expenses (room, board, tuition, and fees) do you expect to cover from each of the sources listed below? (Mark one answer for each possible source)

	None	$1-$499	$500-$999	$1,000-$1,499	$1,500-$1,999	$2,000-$3,000	Over $3,000
a. My Own or Family Resources							
Parents, other relatives or friends	○	○	○	○	○	○	○
Spouse	○	○	○	○	○	○	○
Savings from summer work	○	○	○	○	○	○	○
Other savings	○	○	○	○	○	○	○
Full-time job while in college	○	○	○	○	○	○	○
Part-time job while in college	○	○	○	○	○	○	○
b. Aid Which Need Not Be Repaid							
Pell Grant	○	○	○	○	○	○	○
Supplemental Educational Opportunity Grant	○	○	○	○	○	○	○
State Scholarship or Grant	○	○	○	○	○	○	○
College Work-Study Grant	○	○	○	○	○	○	○
College Grant/Scholarship (other than above)	○	○	○	○	○	○	○
Corporate Tuition Assistance	○	○	○	○	○	○	○
Other private grant	○	○	○	○	○	○	○
Your GI benefits	○	○	○	○	○	○	○
Your parent's GI benefits	○	○	○	○	○	○	○
Other government aid (ROTC, BIA, Social Security, etc.)	○	○	○	○	○	○	○
c. Aid Which Must Be Repaid							
Federal Guaranteed Student Loan	○	○	○	○	○	○	○
National Direct Student Loan	○	○	○	○	○	○	○
Other College Loan	○	○	○	○	○	○	○
Other Loan	○	○	○	○	○	○	○
d. Other Than Above	○	○	○	○	○	○	○

If you are receiving any form of aid indicated in sections b or c, please answer Question No. 20. Otherwise go on to Question 21.

20. Was the aid you are receiving awarded on the basis of: (Mark all that apply)

	Yes	No
Academic merit	○	○
Financial need	○	○
Athletic talent	○	○
Other talent (music, art, etc.)	○	○
Other	○	○

21. Were you last year, or will you be this year:

	1984		1985	
	Yes	No	Yes	No
Living with your parents (for more than five consecutive weeks)	Ⓨ	Ⓝ	Ⓨ	Ⓝ
Listed as a dependent on your parents' Federal Income Tax Return	Ⓨ	Ⓝ	Ⓨ	Ⓝ
Receiving assistance worth $600 or more from your parents	Ⓨ	Ⓝ	Ⓨ	Ⓝ

22. Are you: (Mark all that apply)

- White/Caucasian ○
- Black/Negro/Afro-American ○
- American Indian ○
- Asian-American/Oriental ○
- Mexican-American/Chicano ○
- Puerto Rican-American ○
- Other ○

23. Are you a U.S. citizen? ○ Yes ○ No

24. For the activities below, indicate which ones you did during the past year. If you engaged in an activity frequently, mark Ⓕ. If you engaged in an activity one or more times, but not frequently, mark Ⓞ (occasionally). Mark Ⓝ (not at all) if you have not performed the activity during the past year. (Mark one for each item)

	Frequently	Occasionally	Not at all
Used a personal computer	Ⓕ	Ⓞ	Ⓝ
Played a musical instrument	Ⓕ	Ⓞ	Ⓝ
Attended a religious service	Ⓕ	Ⓞ	Ⓝ
Participated in a speech or debate contest	Ⓕ	Ⓞ	Ⓝ
Elected president of one or more student organizations	Ⓕ	Ⓞ	Ⓝ
Was bored in class	Ⓕ	Ⓞ	Ⓝ
Had a major part in a play	Ⓕ	Ⓞ	Ⓝ
Won a varsity letter for sports	Ⓕ	Ⓞ	Ⓝ
Failed to complete a homework assignment on time	Ⓕ	Ⓞ	Ⓝ
Won a prize or award in an art competition	Ⓕ	Ⓞ	Ⓝ
Edited the school paper, yearbook, or literary magazine	Ⓕ	Ⓞ	Ⓝ
Tutored another student	Ⓕ	Ⓞ	Ⓝ
Asked a teacher for advice after class	Ⓕ	Ⓞ	Ⓝ
Participated in a science contest	Ⓕ	Ⓞ	Ⓝ
Did extra (unassigned) work/reading for a course	Ⓕ	Ⓞ	Ⓝ
Was a guest in a teacher's home	Ⓕ	Ⓞ	Ⓝ
Studied with other students	Ⓕ	Ⓞ	Ⓝ
Overslept and missed a class or appointment	Ⓕ	Ⓞ	Ⓝ
Smoked cigarettes	Ⓕ	Ⓞ	Ⓝ
Performed volunteer work	Ⓕ	Ⓞ	Ⓝ
Missed school because of illness	Ⓕ	Ⓞ	Ⓝ
Attended a recital or concert	Ⓕ	Ⓞ	Ⓝ
Drank beer	Ⓕ	Ⓞ	Ⓝ
Stayed up all night	Ⓕ	Ⓞ	Ⓝ
Felt overwhelmed by all I had to do	Ⓕ	Ⓞ	Ⓝ
Felt depressed	Ⓕ	Ⓞ	Ⓝ

25. Rate yourself on each of the following traits as compared with the average person your age. We want the most accurate estimate of how you see yourself. (Mark one in each row)

	Highest 10%	Above Average	Average	Below Average	Lowest 10%
Academic ability	○	○	○	○	○
Artistic ability	○	○	○	○	○
Drive to achieve	○	○	○	○	○
Emotional health	○	○	○	○	○
Leadership ability	○	○	○	○	○
Mathematical ability	○	○	○	○	○
Physical health	○	○	○	○	○
Popularity	○	○	○	○	○
Self-confidence (intellectual)	○	○	○	○	○
Self-confidence (social)	○	○	○	○	○
Writing ability	○	○	○	○	○

26. In deciding to go to college, how important to you was each of the following reasons? (Mark one answer for each possible reason)

	Very Important	Somewhat Important	Not Important
To be able to get a better job	Ⓥ	Ⓢ	Ⓝ
To gain a general education and appreciation of ideas	Ⓥ	Ⓢ	Ⓝ
To improve my reading and study skills	Ⓥ	Ⓢ	Ⓝ
There was nothing better to do	Ⓥ	Ⓢ	Ⓝ
To make me a more cultured person	Ⓥ	Ⓢ	Ⓝ
To be able to make more money	Ⓥ	Ⓢ	Ⓝ
To learn more about things that interest me	Ⓥ	Ⓢ	Ⓝ
To prepare myself for graduate or professional school	Ⓥ	Ⓢ	Ⓝ
My parents wanted me to go	Ⓥ	Ⓢ	Ⓝ
I could not find a job	Ⓥ	Ⓢ	Ⓝ
Wanted to get away from home	Ⓥ	Ⓢ	Ⓝ

27. Do you have any concern about your ability to finance your college education? (Mark one)

- None (I am confident that I will have sufficient funds) ○
- Some concern (but I will probably have enough funds) ○
- Major concern (not sure I will have enough funds to complete college) ○

28. How would you characterize your political views? (Mark one)

- Far left ○
- Liberal ○
- Middle-of-the-road ○
- Conservative ○
- Far right ○

29. What is your best estimate of your parents' total income last year? Consider income from all sources before taxes. (Mark one)

- ○ Less than $6,000
- ○ $6,000-9,999
- ○ $10,000-14,999
- ○ $15,000-19,999
- ○ $20,000-24,999
- ○ $25,000-29,999
- ○ $30,000-34,999
- ○ $35,000-39,999
- ○ $40,000-49,999
- ○ $50,000-59,999
- ○ $60,000-74,999
- ○ $75,000-99,999
- ○ $100,000-149,999
- ○ $150,000 or more

30. What is the highest level of formal education obtained by your parents? (Mark one in each column)

	Father	Mother
Grammar school or less	○	○
Some high school	○	○
High school graduate	○	○
Postsecondary school other than college	○	○
Some college	○	○
College degree	○	○
Some graduate school	○	○
Graduate degree	○	○

Mark only three responses, one in each column.

Ⓜ Your mother's occupation
Ⓕ Your father's occupation
Ⓨ Your probable career occupation

If your father or mother [illegible] deceased, please indicate his or her last occupation.

Accountant or actuary	Y	F	M
Actor or entertainer	Y	F	M
Architect or urban planner	Y	F	M
Artist	Y	F	M
Business (clerical)	Y	F	M
Business executive (management, administrator)	Y	F	M
Business owner or proprietor	Y	F	M
Business salesperson or buyer	Y	F	M
Clergyman (minister, priest)	Y	F	M
Clergy (other religious)	Y	F	M
Clinical psychologist	Y	F	M
College teacher	Y	F	M
Computer programmer or analyst	Y	F	M
Conservationist or forester	Y	F	M
Dentist (including orthodontist)	Y	F	M
Dietician or home economist	Y	F	M
Engineer	Y	F	M
Farmer or rancher	Y	F	M
Foreign service worker (including diplomat)	Y	F	M
Homemaker (full-time)	Y	F	M
Interior decorator (including designer)	Y	F	M
Interpreter (translator)	Y	F	M
Lab technician or hygienist	Y	F	M
Law enforcement officer	Y	F	M
Lawyer (attorney) or judge	Y	F	M
Military service (career)	Y	F	M
Musician (performer, composer)	Y	F	M
Nurse	Y	F	M
Optometrist	Y	F	M
Pharmacist	Y	F	M
Physician	Y	F	M
School counselor	Y	F	M
School principal or superintendent	Y	F	M
Scientific researcher	Y	F	M
Social, welfare or recreation worker	Y	F	M
Statistician	Y	F	M
Therapist (physical, occupational, speech)	Y	F	M
Teacher or administrator (elementary)	Y	F	M
Teacher or administrator (secondary)	Y	F	M
Veterinarian	Y	F	M
Writer or journalist	Y	F	M
Skilled trades	Y	F	M
Other	Y		
Undecided	Y		
Laborer (unskilled)		F	M
Semi-skilled worker		F	M
Other occupation		F	M
Unemployed		F	M

32. Below are some reasons that might have influenced your decision to attend this particular college. How important was each reason in your decision to come here? (Mark one answer for each possible reason)

	Very important	Somewhat important	Not important
My relatives wanted me to come here	V	S	N
My teacher advised me	V	S	N
This college has a very good academic reputation	V	S	N
This college has a good reputation for its social activities	V	S	N
I was offered financial assistance	V	S	N
This college offers special educational programs	V	S	N
This college has low tuition	V	S	N
My guidance counselor advised me	V	S	N
I wanted to live near home	V	S	N
A friend suggested attending	V	S	N
A college rep. recruited me	V	S	N
The athletic dept. recruited me	V	S	N
This college's graduates gain admission to top graduate/professional schools	V	S	N
This college's graduates get good jobs	V	S	N
Not offered financial aid by first choice college	V	S	N

33. Do you have a disability? (Mark all that apply)

None ○
Hearing ○
Speech ○
Orthopedic ○
Learning disability ○
Health-related ○
Partially sighted or blind ○
Other ○

BE SURE TO ANSWER QUESTIONS 34, 35, AND 36.

34. Current religious preference: (Mark one in each column)

	Yours	Father's	Mother's
Baptist	Y	F	M
Buddhist	Y	F	M
Congregational (U.C.C)	Y	F	M
Eastern Orthodox	Y	F	M
Episcopal	Y	F	M
Islamic	Y	F	M
Jewish	Y	F	M
Latter Day Saints (Mormon)	Y	F	M
Lutheran	Y	F	M
Methodist	Y	F	M
Presbyterian	Y	F	M
Quaker (Society of Friends)	Y	F	M
Roman Catholic	Y	F	M
Seventh Day Adventist	Y	F	M
Other Protestant	Y	F	M
Other Religion	Y	F	M
None	Y	F	M

35. Are you a born-again Christian?

Yes ○ No ○

36. During high school (grades 9-12) how many years did you study each of the following subjects? (Mark one for each item)

	None	½	1	2	3	4	5 or more
English	0	½	1	2	3	4	5
Mathematics	0	½	1	2	3	4	5
Foreign Language	0	½	1	2	3	4	5
Physical Science	0	½	1	2	3	4	5
Biological Science	0	½	1	2	3	4	5
History/Am. Govt.	0	½	1	2	3	4	5
Computer Science	0	½	1	2	3	4	5
Art and/or Music	0	½	1	2	3	4	5

37. Mark one in each row:

① Disagree Strongly
② Disagree Somewhat
③ Agree Somewhat
④ Agree Strongly

	Agree Strongly	Agree Somewhat	Disagree Somewhat	Disagree Strongly
The Federal government is not doing enough to protect the consumer from faulty goods and services	4	3	2	1
The Federal government is not doing enough to promote disarmament	4	3	2	1
The Federal government is not doing enough to control environmental pollution	4	3	2	1
The Federal government should do more to discourage energy consumption	4	3	2	1
The Federal government should raise taxes to help reduce the deficit	4	3	2	1
Federal military spending should be increased	4	3	2	1
Nuclear disarmament is attainable	4	3	2	1
The death penalty should be abolished	4	3	2	1
A national health care plan is needed to cover everybody's medical costs	4	3	2	1
Abortion should be legalized	4	3	2	1
Grading in the high schools has become too easy	4	3	2	1
The activities of married women are best confined to the home and family	4	3	2	1
A couple should live together for some time before deciding to get married	4	3	2	1
Women should receive the same salary and opportunities for advancement as men in comparable positions	4	3	2	1
Wealthy people should pay a larger share of taxes than they do now	4	3	2	1
Marijuana should be legalized	4	3	2	1
Busing is O.K. if it helps to achieve racial balance in the schools	4	3	2	1
It is important to have laws prohibiting homosexual relationships	4	3	2	1
College officials have the right to regulate student behavior off-campus	4	3	2	1
Faculty promotions should be based in part on student evaluations	4	3	2	1
College officials have the right to ban persons with extreme views from speaking on campus	4	3	2	1
Realistically, an individual person can do little to bring about changes in our society	4	3	2	1
The chief benefit of a college education is that it increases one's earning power	4	3	2	1

38. Below is a list of different undergraduate major fields grouped into general categories. Mark only one circle to indicate your probable field of study.

ARTS AND HUMANITIES
- Art, fine and applied ○
- English (language and literature) ○
- History ○
- Journalism ○
- Language and Literature (except English) ○
- Music ○
- Philosophy ○
- Speech ○
- Theater or Drama ○
- Theology or Religion ○
- Other Arts and Humanities ○

BIOLOGICAL SCIENCE
- Biology (general) ○
- Biochemistry or Biophysics ○
- Botany ○
- Marine (Life) Science ○
- Microbiology or Bacteriology ○
- Zoology ○
- Other Biological Science ○

BUSINESS
- Accounting ○
- Business Admin. (general) ○
- Finance ○
- Marketing ○
- Management ○
- Secretarial Studies ○
- Other Business ○

EDUCATION
- Business Education ○
- Elementary Education ○
- Music or Art Education ○
- Physical Education or Recreation ○
- Secondary Education ○
- Special Education ○
- Other Education ○

ENGINEERING
- Aeronautical or Astronautical Eng. ○
- Civil Engineering ○
- Chemical Engineering ○
- Electrical or Electronic Engineering ○
- Industrial Engineering ○
- Mechanical Engineering ○
- Other Engineering ○

PHYSICAL SCIENCE
- Astronomy ○
- Atmospheric Science (incl. Meteorology) ○
- Chemistry ○
- Earth Science ○
- Marine Science (incl. Oceanography) ○
- Mathematics ○
- Physics ○
- Statistics ○
- Other Physical Science ○

PROFESSIONAL
- Architecture or Urban Planning ○
- Home Economics ○
- Health Technology (medical, dental, laboratory) ○
- Library or Archival Science ○
- Nursing ○
- Pharmacy ○
- Predental, Premedicine, Preveterinary ○
- Therapy (occupational, physical, speech) ○
- Other Professional ○

SOCIAL SCIENCE
- Anthropology ○
- Economics ○
- Ethnic Studies ○
- Geography ○
- Political Science (gov't., international relations) ○
- Psychology ○
- Social Work ○
- Sociology ○
- Women's Studies ○
- Other Social Science ○

TECHNICAL
- Building Trades ○
- Data Processing or Computer Programming ○
- Drafting or Design ○
- Electronics ○
- Mechanics ○
- Other Technical ○

OTHER FIELDS
- Agriculture ○
- Communications (radio, TV, etc.) ○
- Computer Science ○
- Forestry ○
- Law Enforcement ○
- Military Science ○
- Other Field ○
- Undecided ○

Prepared by the Higher Education Research Institute, University of California, Los Angeles, California 90024.

39. Indicate the importance to you personally of each of the following: (Mark one for each item)

Ⓔ Essential
Ⓥ Very Important
Ⓢ Somewhat Important
Ⓝ Not Important

Becoming accomplished in one of the performing arts (acting, dancing, etc.)	E	V	S	N
Becoming an authority in my field	E	V	S	N
Obtaining recognition from my colleagues for contributions to my special field	E	V	S	N
Influencing the political structure	E	V	S	N
Influencing social values	E	V	S	N
Raising a family	E	V	S	N
Having administrative responsibility for the work of others	E	V	S	N
Being very well off financially	E	V	S	N
Helping others who are in difficulty	E	V	S	N
Making a theoretical contribution to science	E	V	S	N
Writing original works (poems, novels, short stories, etc.)	E	V	S	N
Creating artistic work (painting, sculpture, decorating, etc.)	E	V	S	N
Being successful in a business of my own	E	V	S	N
Becoming involved in programs to clean up the environment	E	V	S	N
Developing a meaningful philosophy of life	E	V	S	N
Participating in a community action program	E	V	S	N
Helping to promote racial understanding	E	V	S	N
Becoming an expert on finance and commerce	E	V	S	N

40. What is your best guess as to the chances that you will: (Mark one for each item)

Ⓥ Very Good Chance
Ⓢ Some Chance
Ⓛ Very Little Chance
Ⓝ No Chance

Change major field?	V	S	L	N
Change career choice?	V	S	L	N
Fail one or more courses?	V	S	L	N
Graduate with honors?	V	S	L	N
Be elected to a student office?	V	S	L	N
Get a job to help pay for college expenses?	V	S	L	N
Work full time while attending college?	V	S	L	N
Join a social fraternity, sorority, or club?	V	S	L	N
Live in a coeducational dorm?	V	S	L	N
Play varsity/intercollegiate athletics?	V	S	L	N
Be elected to an academic honor society?	V	S	L	N
Make at least a "B" average?	V	S	L	N
Need extra time to complete your degree requirements?	V	S	L	N
Get tutoring help in specific courses?	V	S	L	N
Have to work at an outside job during college?	V	S	L	N
Seek vocational counseling?	V	S	L	N
Seek individual counseling on personal problems?	V	S	L	N
Get a bachelor's degree (B.A., B.S., etc.)?	V	S	L	N
Participate in student protests or demonstrations?	V	S	L	N
Drop out of this college temporarily (exclude transferring)?	V	S	L	N
Drop out permanently (exclude transferring)?	V	S	L	N
Transfer to another college before graduating?	V	S	L	N
Be satisfied with your college?	V	S	L	N
Find a job after college in the field for which you were trained?	V	S	L	N
Get married while in college? (skip if married)	V	S	L	N
Get married within a year after college? (skip if married)	V	S	L	N

The Higher Education Research Institute at UCLA actively encourages the colleges that participate in this survey to conduct local studies of their students. If these studies involve collecting follow-up data, it is necessary for the institution to know the students' ID numbers so that follow-up data can be linked with the data from this survey. If your college asks for a tape copy of the data and signs an agreement to use it only for research purposes, do we have your permission to include your ID number in such a tape?

Yes No

41. A B C D E
42. A B C D E
43. A B C D E
44. A B C D E
45. A B C D E

The remaining circles are provided for items specifically designed by your college, rather than by the Higher Education Research Institute. If your college has chosen to use the circles, observe carefully the supplemental directions given you.

THANK YOU!

46. A B C D E
47. A B C D E
48. A B C D E
49. A B C D E
50. A B C D E

1989

FOLLOW-UP

SURVEY

UNIVERSITY OF CALIFORNIA, LOS ANGELES   UCLA

BERKELEY · DAVIS · IRVINE · LOS ANGELES · RIVERSIDE · SAN DIEGO · SAN FRANCISCO   SANTA BARBARA · SANTA CRUZ

HIGHER EDUCATION RESEARCH INSTITUTE

GRADUATE SCHOOL OF EDUCATION
405 HILGARD AVENUE
LOS ANGELES, CALIFORNIA 90024-1521
(213) 825-1925

FOLLOW-UP SURVEY OF COLLEGE FRESHMEN

June, 1989

You may recall that when you first entered college you participated in a national research project by completing a questionnaire at the beginning of your freshman year. We are now conducting a new survey to follow-up students who responded to this freshman survey in 1985 and 1987. We want to know about your experiences over the past few years, especially your experiences in college. The results of this survey will help to improve higher education programs at campuses across the country.

We ask that you help us by completing the enclosed questionnaire and returning it in the enclosed postage reply envelope. *Please complete the questionnaire even if you withdrew from college or changed schools.* We are very interested in learning about your experiences in college, no matter how long you attended. The information you provide is confidential and will be used only in group comparisons for research purposes.

Some of the colleges that participated in the original freshman surveys have asked us to include additional questions designed specifically for their students. If your college is among this group, you will find an additional page with supplemental questions enclosed in this envelope. Please mark your answers to these supplemental questions at the end of the survey form, as directed. Again, please be assured that your responses are confidential and will be used only for research.

We will be pleased to send you a summary of the findings when they become available. Just mark the appropriate box on the questionnaire.

Your participation is very important to the success of this project. We thank you in advance for your assistance and cooperation.

Sincerely,

Alexander W. Astin

Alexander W. Astin
Professor and Director

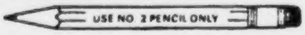
DIRECTIONS:

Your responses will be read by an optical mark reader. Your observance of these few directions will be most appreciated.

- Use only a black lead pencil (No. 2 is ideal).
- Make heavy black marks that fill the oval.
- Erase cleanly any answer you wish to change.
- Make no stray markings of any kind.

EXAMPLE: Will marks made with a ball-point or felt-tip pen be properly read?

○ Yes ● No



1. If you could make your college choice over again, would you still choose to enroll at the college you entered as a freshman?

○ Definitely yes ○ Probably not ○ Don't know
○ Probably I would ○ Definitely not

2. Since entering college have you:

	YES	NO
Enrolled in honors or advanced courses	Ⓨ	Ⓝ
Enrolled in an interdisciplinary course	Ⓨ	Ⓝ
Joined or been a member of a fraternity or sorority	Ⓨ	Ⓝ
Gotten married	Ⓨ	Ⓝ
Had a part-time job on campus	Ⓨ	Ⓝ
Had a part-time job off campus	Ⓨ	Ⓝ
Worked full-time while attending school	Ⓨ	Ⓝ
Participated in a study abroad program	Ⓨ	Ⓝ
Participated in a college internship program	Ⓨ	Ⓝ
Participated in campus protests/demonstrations	Ⓨ	Ⓝ
Been elected to a student office	Ⓨ	Ⓝ
Voted in the 1988 election	Ⓨ	Ⓝ
Graduated with honors	Ⓨ	Ⓝ
Taken reading/study skills classes	Ⓨ	Ⓝ
Participated in intercollegiate athletics	Ⓨ	Ⓝ
Worked on a professor's research project	Ⓨ	Ⓝ
Played intercollegiate football or basketball	Ⓨ	Ⓝ
Taken remedial or developmental courses	Ⓨ	Ⓝ
Purchased a personal computer	Ⓨ	Ⓝ
Enrolled in an ethnic studies course	Ⓨ	Ⓝ
Enrolled in a women's studies course	Ⓨ	Ⓝ
Assisted faculty in teaching a course	Ⓨ	Ⓝ
Attended a racial/cultural awareness workshop	Ⓨ	Ⓝ

3. Which option listed below best describes your enrollment status each year since you entered college?

(Mark one in each column)

	YEAR			
	1	2	3	4
Attended my first college full-time	①	②	③	④
Attended my first college part-time	①	②	③	④
Attended a different college full-time	①	②	③	④
Attended a different college part-time	①	②	③	④
Not enrolled	①	②	③	④

4. Your sex: Male ... ○ Female ... ○

5. Which option listed below best describes where you lived during each year you attended college?

(Mark one in each column)

	YEAR			
	1	2	3	4
With parents or relatives	①	②	③	④
Other private home, apartment, room	①	②	③	④
College dormitory	①	②	③	④
Fraternity or sorority house	①	②	③	④
Other campus student housing	①	②	③	④
Other	①	②	③	④

6. Since entering college as a freshman, have you taken a leave of absence, withdrawn from school, or transferred to another college? (If more than one applies, mark only the most recent)

○ No → **Please go to question 8.**
○ Took a leave of absence
○ Withdrew from school
○ Transferred before completing my program

} **Please answer Question 7**

7. How important were each of the reasons listed below in your decision to take a leave of absence, withdraw from school, or transfer?

(Mark one answer for each reason)

	Very Important	Somewhat Important	Not Important
Wanted to reconsider my goals and interests	Ⓥ	Ⓢ	Ⓝ
Changed my career plans	Ⓥ	Ⓢ	Ⓝ
Wanted practical experience	Ⓥ	Ⓢ	Ⓝ
Didn't feel like I "fit in" at my first college	Ⓥ	Ⓢ	Ⓝ
Was bored with my coursework	Ⓥ	Ⓢ	Ⓝ
Wanted to go to a school with a better academic reputation	Ⓥ	Ⓢ	Ⓝ
Wanted a better social life	Ⓥ	Ⓢ	Ⓝ
Wanted to be closer to home	Ⓥ	Ⓢ	Ⓝ
Had a good job offer	Ⓥ	Ⓢ	Ⓝ
Wasn't doing as well academically as I had expected	Ⓥ	Ⓢ	Ⓝ
Family responsibilities	Ⓥ	Ⓢ	Ⓝ
Tired of being a student	Ⓥ	Ⓢ	Ⓝ
Had money problems and could no longer afford to attend college	Ⓥ	Ⓢ	Ⓝ
Wanted to go to a school that offered a wider selection of courses or more major field choices	Ⓥ	Ⓢ	Ⓝ

8. What do you plan to be doing in the fall of 1989? (Mark all that apply)

○ Attending undergraduate college full-time
○ Attending undergraduate college part-time
○ Attending graduate or professional school
○ Attending a vocational training program
○ Working full-time
○ Working part-time
○ Serving in the Armed Forces
○ Traveling, hosteling, or backpacking
○ Doing volunteer work
○ Staying at home to be with (or start) my family

9. Mark the one circle that best describes your undergraduate grade average.

○ A (3.75-4.0) ○ B-, C+ (2.25-2.74)
○ A-, B+ (3.25-3.74) ○ C (1.75-2.24)
○ B (2.75-3.24) ○ C- or less (below 1.75)

10. Please rate your satisfaction with the college you entered as a freshman on each of the aspects of campus life listed below.

(Mark one for each item)

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Can't Rate - No Experience
Science and mathematics courses	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Humanities courses	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Social science courses	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Courses in your major field	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
General education requirements	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Relevance of coursework to everyday life	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Overall quality of instruction	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Laboratory facilities and equipment	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Library facilities	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Computer facilities	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Opportunities to take interdisciplinary courses	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Opportunities to discuss coursework and assignments outside of class with professors	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Opportunities to participate in extracurricular activities	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Campus social life	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Regulations governing campus life	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Tutorial help or other academic assistance	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Academic advising	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Career counseling and advising	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Personal counseling	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Student housing	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Financial aid services	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Amount of contact with faculty and administrators	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Overall relationships with faculty and administrators	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
On-campus opportunities to attend films, concerts, etc.	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Job placement services for students	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Campus health services	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)
Overall college experience	Ⓥ	Ⓢ	Ⓝ	Ⓓ	(?)

11. Compared with when you entered college as a freshman, how would you now describe your:

(Mark one for each item)

	Much Stronger	Stronger	No Change	Weaker	Much Weaker
General knowledge	⑤	④	③	②	①
Analytical and problem-solving skills	⑤	④	③	②	①
Knowledge of a particular field or discipline	⑤	④	③	②	①
Ability to think critically	⑤	④	③	②	①
Writing skills	⑤	④	③	②	①
Foreign language skills	⑤	④	③	②	①
Job-related skills	⑤	④	③	②	①
Religious beliefs and convictions	⑤	④	③	②	①
Interest in pursuing a graduate/professional degree	⑤	④	③	②	①
Preparation for graduate or professional school	⑤	④	③	②	①
Leadership abilities	⑤	④	③	②	①
Ability to work independently	⑤	④	③	②	①
Interpersonal skills	⑤	④	③	②	①
Cultural awareness and appreciation	⑤	④	③	②	①
Acceptance of persons from different races/cultures	⑤	④	③	②	①
Competitiveness	⑤	④	③	②	①
Confidence in your academic abilities	⑤	④	③	②	①
Public speaking ability	⑤	④	③	②	①
Ability to work cooperatively	⑤	④	③	②	①

12. Indicate the importance to you personally of each of the following:

(Mark one for each item)

	Essential	Very Important	Somewhat Important	Not Important
Becoming accomplished in one of the performing arts (acting, dancing, etc.)	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Becoming an authority in my field	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Obtaining recognition from my colleagues for contributions to my special field	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Influencing the political structure	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Influencing social values	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Raising a family	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Having administrative responsibility for the work of others	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Being very well off financially	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Helping others who are in difficulty	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Making a theoretical contribution to science	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Writing original works (poems, novels, short stories, etc.)	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Creating artistic work (painting, sculpture, decorating, etc.)	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Being successful in a business of my own	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Becoming involved in programs to clean up the environment	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Developing a meaningful philosophy of life	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Participating in a community action program	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Helping to promote racial understanding	Ⓔ	Ⓥ	Ⓢ	Ⓝ
Becoming an expert on finance and commerce	Ⓔ	Ⓥ	Ⓢ	Ⓝ

13. How many undergraduate courses have you taken that emphasized:

(Mark one for each item)

	None	1-2 Courses	3-5 Courses	6-8 Courses	9 or More Courses
Writing skills	○	○	○	○	○
Math/Understanding numerical data	○	○	○	○	○
Science/Scientific Inquiry	○	○	○	○	○
History/Historical Analysis	○	○	○	○	○
Foreign language skills	○	○	○	○	○

14. Indicate how well each of the following describes the college you entered as a freshman.

(Mark one for each item)

	Very Descriptive	Somewhat Descriptive	Not Descriptive
It is easy to see faculty outside of office hours	Ⓥ	Ⓢ	Ⓝ
There is a great deal of conformity among the students	Ⓥ	Ⓢ	Ⓝ
Most of the students are very bright	Ⓥ	Ⓢ	Ⓝ
The administration is open about its policies	Ⓥ	Ⓢ	Ⓝ
There is keen competition among most of the students for high grades	Ⓥ	Ⓢ	Ⓝ
Course work is definitely more theoretical than practical	Ⓥ	Ⓢ	Ⓝ
Faculty are rewarded for their advising skills	Ⓥ	Ⓢ	Ⓝ
Students have little contact with each other outside of class	Ⓥ	Ⓢ	Ⓝ
The faculty are typically at odds with the campus administration	Ⓥ	Ⓢ	Ⓝ
Intercollegiate sports are overemphasized	Ⓥ	Ⓢ	Ⓝ
The classes are usually informal	Ⓥ	Ⓢ	Ⓝ
Faculty here respect each other	Ⓥ	Ⓢ	Ⓝ
Most students are treated like "numbers in a book"	Ⓥ	Ⓢ	Ⓝ
Social activities are overemphasized	Ⓥ	Ⓢ	Ⓝ
There is little or no contact between students and faculty	Ⓥ	Ⓢ	Ⓝ
The student body is apathetic and has little "school spirit"	Ⓥ	Ⓢ	Ⓝ
Students here do not usually socialize with one another	Ⓥ	Ⓢ	Ⓝ
Faculty are rewarded for being good teachers	Ⓥ	Ⓢ	Ⓝ

15. **Please indicate your agreement with each of the following statements.**

(Mark one for each item)

	Agree Strongly	Agree Somewhat	Disagree Somewhat	Disagree Strongly
The Federal government is not doing enough to promote disarmament	④	③	②	①
The Federal government is not doing enough to control environmental pollution	④	③	②	①
The Federal government should raise taxes to help reduce the deficit	④	③	②	①
The death penalty should be abolished	④	③	②	①
A national health care plan is needed to cover everybody's medical costs	④	③	②	①
Abortion should be legalized	④	③	②	①
Grading in colleges has become too easy	④	③	②	①
The activities of married women are best confined to the home and family	④	③	②	①
Women should receive the same salary and opportunities for advancement as men in comparable positions	④	③	②	①
Wealthy people should pay a larger share of taxes than they do now	④	③	②	①
Marijuana should be legalized	④	③	②	①
Busing is O.K. if it helps to achieve racial balance in the schools	④	③	②	①
College officials have the right to regulate student behavior off campus	④	③	②	①
College officials have the right to ban persons with extreme views from speaking on campus	④	③	②	①
Realistically, an individual person can do little to bring about changes in our society	④	③	②	①
The chief benefit of a college education is that it increases one's earning power	④	③	②	①
Racial discrimination is no longer a major problem in America	④	③	②	①
Colleges should be actively involved in solving social problems	④	③	②	①
The best way to control the spread of AIDS is through widespread mandatory testing	④	③	②	①
Just because a man feels a woman has "led him on" does not entitle him to have sex with her	④	③	②	①

16. **Below are some statements about the college you entered as a freshman. Indicate the extent to which you agree or disagree.**

(Mark one for each item)

	Agree Strongly	Agree Somewhat	Disagree Somewhat	Disagree Strongly
Faculty here are interested in students' personal problems	④	③	②	①
Most faculty here are sensitive to the issues of minorities	④	③	②	①
The curriculum here has suffered from faculty over-specialization	④	③	②	①
Many students feel like they do not "fit in" on this campus	④	③	②	①
Faculty are committed to the welfare of this institution	④	③	②	①
Many courses include minority group perspectives	④	③	②	①
Administrators consider student concerns when making policy	④	③	②	①
Faculty here are strongly interested in the academic problems of undergraduates	④	③	②	①
There is a lot of campus racial conflict here	④	③	②	①
Students here resent taking required courses outside their major	④	③	②	①
Students of different racial/ethnic origins communicate well with one another	④	③	②	①
Campus administrators care little about what happens to students	④	③	②	①
There is little trust between minority student groups and campus administrators	④	③	②	①
Faculty here are positive about the general education program	④	③	②	①
Many courses include feminist perspectives	④	③	②	①
There are many opportunities for faculty and students to socialize with one another	④	③	②	①
Administrators consider faculty concerns when making policy	④	③	②	①
Faculty feel that most students here are well-prepared academically	④	③	②	①

17. **During your last year in college, how much time did you spend during a typical week doing the following activities?**

(Mark one for each item)

	Hours Per Week							
	None	Less than 1 hour	1-2	3-5	6-10	11-15	16-20	Over 20
Classes/labs	○	○	○	○	○	○	○	○
Studying/homework	○	○	○	○	○	○	○	○
Socializing with friends	○	○	○	○	○	○	○	○
Talking with faculty outside of class	○	○	○	○	○	○	○	○
Exercising/sports	○	○	○	○	○	○	○	○
Reading for pleasure	○	○	○	○	○	○	○	○
Using a personal computer	○	○	○	○	○	○	○	○
Partying	○	○	○	○	○	○	○	○
Working (for pay)	○	○	○	○	○	○	○	○
Volunteer work	○	○	○	○	○	○	○	○
Student clubs/groups	○	○	○	○	○	○	○	○
Watching TV	○	○	○	○	○	○	○	○
Commuting to campus	○	○	○	○	○	○	○	○
Religious services/meetings	○	○	○	○	○	○	○	○
Hobbies	○	○	○	○	○	○	○	○

18. **For the activities listed below, please indicate how often — Frequently, Occasionally, or Not at all — you engaged in each during the past year.**

(Mark one for each item)

	Frequently	Occasionally	Not at all
Worked on an independent research project	Ⓕ	Ⓞ	Ⓝ
Discussed course content with students outside of class	Ⓕ	Ⓞ	Ⓝ
Worked on group projects for a class	Ⓕ	Ⓞ	Ⓝ
Been a guest in a professor's home	Ⓕ	Ⓞ	Ⓝ
Took a multiple-choice exam	Ⓕ	Ⓞ	Ⓝ
Tutored another student	Ⓕ	Ⓞ	Ⓝ
Smoked cigarettes	Ⓕ	Ⓞ	Ⓝ
Felt depressed	Ⓕ	Ⓞ	Ⓝ
Felt overwhelmed by all I had to do	Ⓕ	Ⓞ	Ⓝ
Stayed up all night	Ⓕ	Ⓞ	Ⓝ
Gave a presentation in class	Ⓕ	Ⓞ	Ⓝ
Participated in intramural sports	Ⓕ	Ⓞ	Ⓝ
Discussed racial/ethnic issues	Ⓕ	Ⓞ	Ⓝ
Attended a recital or concert	Ⓕ	Ⓞ	Ⓝ
Missed classes because of illness	Ⓕ	Ⓞ	Ⓝ
Felt like leaving college	Ⓕ	Ⓞ	Ⓝ
Failed to complete a homework assignment on time	Ⓕ	Ⓞ	Ⓝ
Drank beer	Ⓕ	Ⓞ	Ⓝ
Drank wine or liquor	Ⓕ	Ⓞ	Ⓝ
Received career/vocational counseling	Ⓕ	Ⓞ	Ⓝ
Received personal/psychological counseling	Ⓕ	Ⓞ	Ⓝ
Participated in campus protests/demonstrations	Ⓕ	Ⓞ	Ⓝ
Took an essay exam	Ⓕ	Ⓞ	Ⓝ
Received tutoring in courses	Ⓕ	Ⓞ	Ⓝ
Read the student newspaper	Ⓕ	Ⓞ	Ⓝ
Socialized with someone of another racial/ethnic group	Ⓕ	Ⓞ	Ⓝ
Discussed political/social issues	Ⓕ	Ⓞ	Ⓝ
Had a class paper critiqued by an instructor	Ⓕ	Ⓞ	Ⓝ

19. Please indicate (A) the highest degree you have earned as of June 1989 and (B) the highest degree you plan to complete.

(Mark one in each column)

	Highest Degree Earned	Highest Degree Planned
None	Ⓐ	Ⓑ
Vocational certificate	Ⓐ	Ⓑ
Associate's degree (A.A. or equivalent)	Ⓐ	Ⓑ
Bachelor's degree (B.A., B.S., etc.)	Ⓐ	Ⓑ
Master's degree (M.A., M.S., etc.)	Ⓐ	Ⓑ
Ph.D. or Ed.D.	Ⓐ	Ⓑ
M.D., D.O., D.D.S., or D.V.M.	Ⓐ	Ⓑ
LL.B., or J.D. (Law)	Ⓐ	Ⓑ
B.D. or M.DIV. (Divinity)	Ⓐ	Ⓑ
Other	Ⓐ	Ⓑ

20. How would you characterize your political views? (Mark one)

- Far left ○
- Liberal ○
- Middle-of-the-road ○
- Conservative ○
- Far right ○

21. Rate yourself on each of the following traits as compared with the average person your age. We want the most accurate estimate of how you see yourself.

(Mark one for each item)

	Highest 10%	Above Average	Average	Below Average	Lowest 10%
Academic ability	○	○	○	○	○
Artistic ability	○	○	○	○	○
Drive to achieve	○	○	○	○	○
Emotional health	○	○	○	○	○
Leadership ability	○	○	○	○	○
Mathematical ability	○	○	○	○	○
Physical health	○	○	○	○	○
Popularity	○	○	○	○	○
Self-confidence (intellectual)	○	○	○	○	○
Self-confidence (social)	○	○	○	○	○
Writing ability	○	○	○	○	○
Listening ability	○	○	○	○	○

22. Your current religious preference: (Mark one)

- Baptist ○
- Buddhist ○
- Congregational (UCC) ○
- Eastern Orthodox ○
- Episcopal ○
- Islamic ○
- Jewish ○
- Latter Day Saints (Mormon) ○
- Lutheran ○
- Methodist ○
- Presbyterian ○
- Quaker ○
- Roman Catholic ○
- Seventh Day Adventist ○
- Other Protestant ○
- Other Religion ○
- None ○

23. Are you a born-again Christian? ○ Yes ○ No

24. Are you: (Mark one)

- Not presently married ○
- Married, living with spouse ○
- Married, not living with spouse ○

25. Please mark your probable career/occupation below: (Mark one)

- Accountant or actuary ○
- Actor or entertainer ○
- Architect or urban planner ○
- Artist ○
- Business (clerical) ○
- Business executive (management, administrator) ○
- Business owner or proprietor ○
- Business salesperson or buyer ○
- Clergy (minister, priest) ○
- Clergy (other religious) ○
- Clinical psychologist ○
- College teacher ○
- Computer programmer or analyst ○
- Conservationist or forester ○
- Dentist (including orthodontist) ○
- Dietitian or home economist ○
- Engineer ○
- Farmer or rancher ○
- Foreign service worker (including diplomat) ○
- Homemaker (full-time) ○
- Interior decorator (including designer) ○
- Interpreter (translator) ○
- Lab technician or hygienist ○
- Law enforcement officer ○
- Lawyer (attorney) or judge ○
- Military service (career) ○
- Musician (performer, composer) ○
- Nurse ○
- Optometrist ○
- Pharmacist ○
- Physician ○
- School counselor ○
- School principal or superintendent ○
- Scientific researcher ○
- Social, welfare or recreation worker ○
- Statistician ○
- Therapist (physical, occupational, speech) ○
- Teacher or administrator (elementary) ○
- Teacher or administrator (secondary) ○
- Veterinarian ○
- Writer or journalist ○
- Skilled trades ○
- Other ○
- Undecided ○

26. How important are each of the following reasons for your career choice or career preference?

(Mark one for each item)

	Essential	Very Important	Somewhat Important	Not Important
Job opportunities are generally available	Ⓔ	Ⓥ	Ⓢ	Ⓝ
I enjoy working with the kind of people involved in this field	Ⓔ	Ⓥ	Ⓢ	Ⓝ
The work would be interesting	Ⓔ	Ⓥ	Ⓢ	Ⓝ
This is a well-paying career	Ⓔ	Ⓥ	Ⓢ	Ⓝ
This choice satisfies my parents' hopes	Ⓔ	Ⓥ	Ⓢ	Ⓝ
The work would be challenging	Ⓔ	Ⓥ	Ⓢ	Ⓝ
I feel this enables me to make a contribution to society	Ⓔ	Ⓥ	Ⓢ	Ⓝ
There are opportunities for rapid career advancement	Ⓔ	Ⓥ	Ⓢ	Ⓝ
There are opportunities for freedom of action	Ⓔ	Ⓥ	Ⓢ	Ⓝ

27. Indicate how important you believe each priority listed below is at the college or university you entered as a freshman.

(Mark one for each item)

	Highest Priority	High Priority	Medium Priority	Low Priority
To promote the intellectual development of students	④	③	②	①
To help students examine and understand their personal values	④	③	②	①
To increase the representation of minorities in the faculty and administration	④	③	②	①
To develop a sense of community among students and faculty	④	③	②	①
To develop leadership ability among students	④	③	②	①
To conduct basic and applied research	④	③	②	①
To raise money for the institution	④	③	②	①
To develop leadership ability among faculty	④	③	②	①
To increase the representation of women in the faculty and administration	④	③	②	①
To facilitate student involvement in community service activities	④	③	②	①
To help students learn how to bring about change in American society	④	③	②	①
To help solve major social and environmental problems	④	③	②	①
To maintain a campus climate where differences of opinion can be aired openly	④	③	②	①
To increase or maintain institutional prestige	④	③	②	①
To develop among students and faculty an appreciation for a multi-cultural society	④	③	②	①
To hire faculty "stars"	④	③	②	①
To economize and cut costs	④	③	②	①
To recruit more minority students	④	③	②	①
To enhance the institution's national image	④	③	②	①
To create a positive undergraduate experience	④	③	②	①
To create a diverse multi-cultural environment on campus	④	③	②	①

28. **Below is a list of different major fields.** (Mark only one in each column)

Ⓤ Undergraduate major (final or most recent)

Ⓖ Graduate major (omit if you do not plan to go to graduate school)

ARTS AND HUMANITIES
- Art, fine and applied ...... Ⓤ Ⓖ
- English (language and literature) ...... Ⓤ Ⓖ
- History ...... Ⓤ Ⓖ
- Journalism ...... Ⓤ Ⓖ
- Language and Literature (except English) ...... Ⓤ Ⓖ
- Music ...... Ⓤ Ⓖ
- Philosophy ...... Ⓤ Ⓖ
- Speech ...... Ⓤ Ⓖ
- Theater or Drama ...... Ⓤ Ⓖ
- Theology or Religion ...... Ⓤ Ⓖ
- Other Arts and Humanities ...... Ⓤ Ⓖ

BIOLOGICAL SCIENCE
- Biology (general) ...... Ⓤ Ⓖ
- Biochemistry or Biophysics ...... Ⓤ Ⓖ
- Botany ...... Ⓤ Ⓖ
- Marine (Life) Science ...... Ⓤ Ⓖ
- Microbiology or Bacteriology ...... Ⓤ Ⓖ
- Zoology ...... Ⓤ Ⓖ
- Other Biological Science ...... Ⓤ Ⓖ

BUSINESS
- Accounting ...... Ⓤ Ⓖ
- Business Administration (general) ...... Ⓤ Ⓖ
- Finance ...... Ⓤ Ⓖ
- Marketing ...... Ⓤ Ⓖ
- Management ...... Ⓤ Ⓖ
- Secretarial Studies ...... Ⓤ Ⓖ
- Other Business ...... Ⓤ Ⓖ

EDUCATION
- Business Education ...... Ⓤ Ⓖ
- Elementary Education ...... Ⓤ Ⓖ
- Music or Art Education ...... Ⓤ Ⓖ
- Physical Education or Recreation ...... Ⓤ Ⓖ
- Secondary Education ...... Ⓤ Ⓖ
- Special Education ...... Ⓤ Ⓖ
- Other Education ...... Ⓤ Ⓖ

ENGINEERING
- Aeronautical or Astronautical Engineering ...... Ⓤ Ⓖ
- Civil Engineering ...... Ⓤ Ⓖ
- Chemical Engineering ...... Ⓤ Ⓖ
- Electrical or Electronic Engineering ...... Ⓤ Ⓖ
- Industrial Engineering ...... Ⓤ Ⓖ
- Mechanical Engineering ...... Ⓤ Ⓖ
- Other Engineering ...... Ⓤ Ⓖ

PHYSICAL SCIENCE
- Astronomy ...... Ⓤ Ⓖ
- Atmospheric Science (incl. Meteorology) ...... Ⓤ Ⓖ
- Chemistry ...... Ⓤ Ⓖ
- Earth Science ...... Ⓤ Ⓖ
- Marine Science (incl. Oceanography) ...... Ⓤ Ⓖ
- Mathematics ...... Ⓤ Ⓖ
- Physics ...... Ⓤ Ⓖ
- Statistics ...... Ⓤ Ⓖ
- Other Physical Science ...... Ⓤ Ⓖ

PROFESSIONAL
- Architecture or Urban Planning ...... Ⓤ Ⓖ
- Home Economics ...... Ⓤ Ⓖ
- Health Technology (medical, dental, laboratory) ...... Ⓤ Ⓖ
- Law ...... Ⓖ
- Library/Archival Science ...... Ⓤ Ⓖ
- Nursing ...... Ⓤ Ⓖ
- Pharmacy ...... Ⓤ Ⓖ
- Predental, Premedicine, Preveterinary ...... Ⓤ Ⓖ
- Therapy (occupational, physical, speech) ...... Ⓤ Ⓖ
- Other Professional ...... Ⓤ Ⓖ

SOCIAL SCIENCE
- Anthropology ...... Ⓤ Ⓖ
- Economics ...... Ⓤ Ⓖ
- Ethnic Studies ...... Ⓤ Ⓖ
- Geography ...... Ⓤ Ⓖ
- Political Science (gov't., international relations) ...... Ⓤ Ⓖ
- Psychology ...... Ⓤ Ⓖ
- Social Work ...... Ⓤ Ⓖ
- Sociology ...... Ⓤ Ⓖ
- Women's Studies ...... Ⓤ Ⓖ
- Other Social Science ...... Ⓤ Ⓖ

TECHNICAL
- Building Trades ...... Ⓤ Ⓖ
- Data Processing or Computer Programming ...... Ⓤ Ⓖ
- Drafting or Design ...... Ⓤ Ⓖ
- Electronics ...... Ⓤ Ⓖ
- Mechanics ...... Ⓤ Ⓖ
- Other Technical ...... Ⓤ Ⓖ

OTHER FIELDS
- Agriculture ...... Ⓤ Ⓖ
- Communications (radio, TV, etc.) ...... Ⓤ Ⓖ
- Computer Science ...... Ⓤ Ⓖ
- Forestry ...... Ⓤ Ⓖ
- Law Enforcement ...... Ⓤ Ⓖ
- Military Science ...... Ⓤ Ⓖ
- Other Field ...... Ⓤ Ⓖ
- Undecided ...... Ⓤ Ⓖ

29. **If you have attended more than one undergraduate college, please write in the name and location of the current (or most recent) college attended. (Please print)**

Institution ______ State ______

30. **If you have been admitted to a graduate or professional school, please write in the name of the institution and its location. (Please print)**

Institution ______ State ______

31. **Please provide the following information about your scores on the tests listed below:**

GRE: Verbal ☐☐☐ **GRE: Quantitative** ☐☐☐

LSAT ☐☐☐ **MCAT** ☐☐

32. **Would you like to receive a copy of the results of this survey?**

○ Yes ○ No

33. **The Higher Education Research Institute at UCLA actively encourages the colleges that participate in this survey to conduct local studies of their students. If your college asks for a tape copy of the data and signs an agreement to use it only for research purposes, do we have your permission to include your ID number in such a tape?**

○ Yes ○ No

34. **Please provide your Social Security Number:**

⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①	①	①	①
②	②	②	②	②	②	②	②	②
③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

ADDITIONAL QUESTIONS: If you received an additional page of questions, please mark your answers below:

35. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
36. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
37. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
38. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
39. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
40. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
41. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
42. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
43. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
44. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
45. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
46. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
47. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
48. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
49. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
50. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
51. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
52. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
53. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
54. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

55. **Please update the name and address information printed on the front page of this questionnaire:**

First Name: ☐☐☐☐☐☐☐☐☐☐☐☐☐ **MI:** ☐

Last Name: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Street Address: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

City: ☐☐☐☐☐☐☐☐☐☐☐☐☐

State: ☐☐ **ZIP Code:** ☐☐☐☐☐

Area Code: ☐☐☐ **Phone:** ☐☐☐-☐☐☐☐

Birthdate: Month: ☐☐ **Day:** ☐☐ **Year:** ☐☐

THANK YOU!

Please return your completed questionnaire in the postage-paid envelope to:

Higher Education Research Institute
2905 W. Service Rd.
Eagan, MN 55121

⓪	⓪	⓪	⓪	⓪	⓪
①	①	①	①	①	①
②	②	②	②	②	②
③	③	③	③	③	③
④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨

① ② ③

311

2996-Questar 940-54321

1989

FACULTY

SURVEY

1989 Faculty Survey

Higher Education Research Institute, UCLA

DIRECTIONS

Your responses will be read by an optical mark reader. Your observance of these few directions will be most appreciated.

- Use only a black lead pencil (No. 2 is ideal)
- Make heavy black marks that fill the oval.
- Erase cleanly any answer you wish to change.
- Make no stray markings of any kind.

EXAMPLE: Will marks made with a ball-point or felt-tip pen be properly read?

○ Yes ● No

1. What is your principal activity in your current position at this institution? (Mark one)

○ Administration
○ Teaching
○ Research
○ Services to clients and patients
○ Other

2. Are you considered a full-time employee of your institution for at least nine months of the current academic year? (Mark one)

○ Yes ○ No

3. What is your present academic rank?

○ Professor
○ Associate Professor
○ Assistant Professor
○ Lecturer
○ Instructor
○ Other

4. What is your administrative title?

○ Not applicable
○ Director, coordinator, or administrator of an institute, center, lab, or specially-funded program
○ Department Chair
○ Dean
○ Associate or Assistant Dean
○ Vice-President, Provost, Vice-Chancellor
○ President, Chancellor
○ Other

. Your sex:

○ Male ○ Female

. Your marital status.

○ Married (currently)
○ Separated
○ Single (never married)
○ Single (with partner)
○ Single (divorced)
○ Single (widowed)

. If you were to begin your career again, would you still want to be a college professor?

○ Definitely yes
○ Probably yes
○ Not sure
○ Probably no
○ Definitely no

8. Racial/Ethnic group: (Mark all that apply)

○ White Caucasian
○ Black Negro Afro-American
○ American Indian
○ Asian-American
○ Mexican-American Chicano
○ Puerto Rican-American
○ Other

9. Do your interests lie primarily in teaching or research?

○ Very heavily in research
○ In both, but leaning toward research
○ In both, but leaning toward teaching
○ Very heavily in teaching

10. Which of these statements applies to your current research or scholarly endeavors? (Mark one)

○ I am essentially working alone
○ I am working with one or two colleagues
○ I am a member of a larger group

11. On the following list, please mark: (Mark one in each column)

	Highest Degree Earned	Degree Currently Working On
Bachelor's (B.A., B.S., etc.)	○	○
Master's (M.A., M.S., etc.)	○	○
LL.B., J.D.	○	○
M.D., D.D.S. (or equivalent)	○	○
Other first professional degree beyond B.A. (e.g., D.D., D.V.M.)	○	○
Ed.D.	○	○
Ph.D.	○	○
Other degree	○	○
None	○	○

12. During the past two years, have you engaged in any of the following activities? (Mark one for each item)

	Yes	No
Taught an honors course	○	○
Taught an interdisciplinary course	○	○
Taught a general education course	○	○
Taught a developmental/remedial course	○	○
Taught an ethnic studies course	○	○
Taught a women's studies course	○	○
Team-taught a course	○	○
Worked with students on a research project	○	○
Attended a racial/cultural awareness workshop	○	○
Participated in a faculty seminar to integrate women's and minorities' perspectives in regular courses	○	○
Held a faculty senate or council office	○	○
Used intra- or extramural funds for research	○	○
Served as a paid consultant	○	○

13. In the two sets of ovals shown below, please mark the most appropriate code from the fields listed on the back of the accompanying letter. (Please see example on back of accompanying letter)

Major of highest degree held		Department of current faculty appointment	
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

14. In the set of ovals to the right, please mark the dollar value of your base institutional salary, rounded to the nearest $1,000 (Note: Amounts above $99,000 should be marked "99").

0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

The above salary is based on

○ 9-10 months ○ 11-12 months

15. In the four sets of circles below, please mark the last two digits of the year of each of the following:

Year of birth		Year of highest degree now held	
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Year of appointment at present institution		If tenured, year tenure awarded at current institution	
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

○ Not Tenured

NOTE: If you are now between terms (quarters, semesters, trimesters), on leave, or in an interim term, please answer questions 16 and 17 as they apply to the full term most recently completed at this institution.

16. During the present term, how many hours per week on the average do you actually spend in connection with your present position on each of the following activities?

(Mark one for each activity)

	Hours Per Week								
	None	1-4	5-8	9-12	13-16	17-20	21-34	35-44	45+
Scheduled teaching (give actual, not credit, hours)	○	○	○	○	○	○	○	○	○
Preparing for teaching (including reading student papers and grading)	○	○	○	○	○	○	○	○	○
Advising and counseling of students	○	○	○	○	○	○	○	○	○
Committee work and meetings	○	○	○	○	○	○	○	○	○
Other administration	○	○	○	○	○	○	○	○	○
Research and scholarly writing	○	○	○	○	○	○	○	○	○
Consultation with clients, patients	○	○	○	○	○	○	○	○	○

17. How many of the following courses are you teaching this term? (Mark one for each item)

General education courses	0	1	2	3	4	5
Other BA or BS undergraduate credit courses	0	1	2	3	4	5
Non-BA credit courses (developmental and/or remedial)	0	1	2	3	4	5
Graduate courses	0	1	2	3	4	5

18. How would you characterize your political views?

- ○ Far Left
- ○ Liberal
- ○ Moderate
- ○ Conservative
- ○ Far Right

19. Indicate the importance to you of each of the following:

(Mark one for each item)

	Essential	Very Important	Somewhat Important	Not Important
Education Goals for Undergraduate Students:				
Develop ability to think clearly	E	V	S	N
Increase desire and ability to undertake self-directed learning	E	V	S	N
Prepare students for employment after college	E	V	S	N
Prepare students for graduate or advanced education	E	V	S	N
Develop moral character	E	V	S	N
Provide for students' emotional development	E	V	S	N
Prepare students for family living	E	V	S	N
Teach students the classic works of Western civilization	E	V	S	N
Help students develop personal values	E	V	S	N
Enhance the out-of-class experience of students	E	V	S	N
Enhance students' self-understanding	E	V	S	N
Personal/Professional Goals:				
Engage in research	E	V	S	N
Engage in outside activities	E	V	S	N
Provide services to the community	E	V	S	N
Participate in committee or other administrative work	E	V	S	N
Be a good colleague	E	V	S	N
Be a good teacher	E	V	S	N

For questions 20-24, please mark only one response for each question.

	None	1-2	3-4	5-10	11-20	21-50	50+
20. How many articles have you published in academic or professional journals?	○	○	○	○	○	○	○
21. How many chapters have you published in edited volumes?	○	○	○	○	○	○	○
22. How many books, manuals, or monographs have you written or edited, alone or in collaboration?	○	○	○	○	○	○	○
23. How many of your professional writings have been published or accepted for publication in the last two years?	○	○	○	○	○	○	○
24. About how many days during the past (1988-89) academic year were you away from campus for professional activities (e.g., professional meetings, speeches, consulting)?	○	○	○	○	○	○	○

25. What is the highest level of education reached by your spouse/partner and your parents? (Mark one in each column)

	Spouse/Partner	Father	Mother
8th grade or less	S	F	M
Some high school	S	F	M
Completed high school	S	F	M
Some college	S	F	M
Graduated from college	S	F	M
Attended graduate or professional school	S	F	M
Attained advanced degree	S	F	M
Does not apply (No spouse or partner)	S		

26. For each of the following items, please mark either Yes or No.

	Yes	No
Have you ever held an academic administrative post?	○	○
Have you ever received an award for outstanding teaching?	○	○
Is your spouse or live-in partner an academic?	○	○
Do you commute a long distance to work?	○	○
Has any of your research or writing focused on women or gender?	○	○
Has any of your research or writing focused on racial or ethnic minorities?	○	○
Do you have dependent children?	○	○
Are you a U.S. citizen?	○	○
Have you ever interrupted your professional career for more than one year for health or family reasons?	○	○
Have you ever considered a career in academic administration?	○	○
Do you plan on working beyond age 70?	○	○
During the Last Two Years, Have You:		
Received at least one firm job offer?	○	○
Participated in a faculty development program?	○	○
Developed a new course?	○	○
Considered early retirement?	○	○
Considered leaving academe for another job?	○	○

27. Indicate how important you believe each priority listed below is at your college or university.

(Mark one for each item)

	Highest Priority	High Priority	Medium Priority	Low Priority
To promote the intellectual development of students	④	③	②	①
To help students examine and understand their personal values	④	③	②	①
To increase the representation of minorities in the faculty and administration	④	③	②	①
To develop a sense of community among students and faculty	④	③	②	①
To develop leadership ability among students	④	③	②	①
To conduct basic and applied research	④	③	②	①
To raise money for the institution	④	③	②	①
To develop leadership ability among faculty	④	③	②	①
To increase the representation of women in the faculty and administration	④	③	②	①
To facilitate student involvement in community service activities	④	③	②	①
To help students learn how to bring about change in American society	④	③	②	①
To help solve major social and environmental problems	④	③	②	①
To maintain a campus climate where differences of opinion can be aired openly	④	③	②	①
To increase or maintain institutional prestige	④	③	②	①
To develop among students and faculty an appreciation for a multi-cultural society	④	③	②	①
To hire faculty "stars"	④	③	②	①
To economize and cut costs	④	③	②	①
To recruit more minority students	④	③	②	①
To enhance the institution's national image	④	③	②	①
To create a positive undergraduate experience	④	③	②	①
To create a diverse multi-cultural environment on campus	④	③	②	①
To enhance the out-of-class experience of students	④	③	②	①

28. Please indicate the extent to which each of the following has been a source of stress for you during the last two years.

(Mark one for each item)

	Extensive	Somewhat	Not At All
Managing household responsibilities	Ⓔ	Ⓢ	Ⓝ
Child care	Ⓔ	Ⓢ	Ⓝ
Care of elderly parents	Ⓔ	Ⓢ	Ⓝ
My physical health	Ⓔ	Ⓢ	Ⓝ
Review/promotion process	Ⓔ	Ⓢ	Ⓝ
Subtle discrimination (including prejudice, racism, sexism)	Ⓔ	Ⓢ	Ⓝ
Long-distance commuting	Ⓔ	Ⓢ	Ⓝ
Committee work	Ⓔ	Ⓢ	Ⓝ
Faculty meetings	Ⓔ	Ⓢ	Ⓝ
Colleagues	Ⓔ	Ⓢ	Ⓝ
Students	Ⓔ	Ⓢ	Ⓝ
Research or publishing demands	Ⓔ	Ⓢ	Ⓝ
Fund raising expectations	Ⓔ	Ⓢ	Ⓝ
Teaching load	Ⓔ	Ⓢ	Ⓝ
Children's problems	Ⓔ	Ⓢ	Ⓝ
Marital friction	Ⓔ	Ⓢ	Ⓝ
Time pressures	Ⓔ	Ⓢ	Ⓝ
Lack of personal time	Ⓔ	Ⓢ	Ⓝ

29. How satisfied are you with the following aspects of your job?

(Mark one for each item)

	Very Satisfied	Satisfied	Marginally Satisfied	Not Satisfied	Not Applicable
Salary and fringe benefits	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Opportunity for scholarly pursuits	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Teaching load	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Quality of students	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Working conditions (hours, location)	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Autonomy and independence	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Relationships with other faculty	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Competency of colleagues	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Visibility for jobs at other institutions/organizations	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Job security	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Undergraduate course assignments	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Graduate course assignments	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Relationships with administration	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○
Overall job satisfaction	Ⓥ	Ⓢ	Ⓜ	Ⓝ	○

30. Below are some statements about your current college. Indicate the extent to which you agree or disagree with each of the following:

(Mark one for each item)

	Agree Strongly	Agree Somewhat	Disagree Somewhat	Disagree Strongly
Faculty here are interested in students' personal problems	④	③	②	①
Most faculty here are sensitive to the issues of minorities	④	③	②	①
The curriculum here has suffered from faculty overspecialization	④	③	②	①
Many students feel like they do not "fit in" on this campus	④	③	②	①
Faculty are committed to the welfare of this institution	④	③	②	①
Many courses include minority group perspectives	④	③	②	①
Administrators consider student concerns when making policy	④	③	②	①
Faculty here are strongly interested in the academic problems of undergraduates	④	③	②	①
There is a lot of campus racial conflict here	④	③	②	①
Students here resent taking courses outside their major	④	③	②	①
Students of different racial/ethnic origins communicate well with one another	④	③	②	①
Campus administrators care little about what happens to students	④	③	②	①
There is little trust between minority student groups and campus administrators	④	③	②	①
Faculty here are positive about the general education program	④	③	②	①
Many courses include feminist perspectives	④	③	②	①
There are many opportunities for faculty and students to socialize with one another	④	③	②	①
Administrators consider faculty concerns when making policy	④	③	②	①
Faculty feel that most students are well prepared academically	④	③	②	①
Student Affairs staff have the support and respect of faculty	④	③	②	①
Institutional demands for doing research interfere with my effectiveness as a teacher	④	③	②	①

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31. Indicate how well each of the following describes your college or university.

(Mark one for each item)

	Very Descriptive	Somewhat Descriptive	Not Descriptive
It is easy for students to see faculty outside of regular office hours	V	S	N
There is a great deal of conformity among the students	V	S	N
Most of the students are very bright	V	S	N
The administration is open about its policies	V	S	N
There is keen competition among most of the students for high grades	V	S	N
Course work is definitely more theoretical than practical	V	S	N
Faculty are rewarded for their advising skills	V	S	N
Students have little contact with each other outside of class	V	S	N
The faculty are typically at odds with the campus administration	V	S	N
Intercollegiate sports are overemphasized	V	S	N
The classes are usually informal	V	S	N
Faculty here respect each other	V	S	N
Most students are treated like "numbers in a book"	V	S	N
Social activities are overemphasized	V	S	N
There is little or no contact between students and faculty	V	S	N
The student body is apathetic and has little "school spirit"	V	S	N
Students here do not usually socialize with one another	V	S	N
Faculty are rewarded for being good teachers	V	S	N
Student services are well supported on this campus	V	S	N

32. In how many of the undergraduate courses that you teach, do you require each of the following?

(Mark one for each item)

Evaluation Methods:	All	Most	Some	None
Multiple-choice mid-term and/or final exams	A	M	S	N
Essay mid-term and/or final exams	A	M	S	N
Short-answer mid-term and/or final exams	A	M	S	N
Multiple-choice quizzes	A	M	S	N
Short-answer quizzes	A	M	S	N
Weekly essay assignments	A	M	S	N
Student presentations	A	M	S	N
Term/research papers	A	M	S	N
Student evaluations of each others' work	A	M	S	N
Grading on a curve	A	M	S	N
Competency-based grading	A	M	S	N
Student evaluations of teaching	A	M	S	N
Instructional Techniques/Methods:				
Class discussions	A	M	S	N
Computer or machine-aided instruction	A	M	S	N
Cooperative learning (small groups)	A	M	S	N
Experiential learning/Field studies	A	M	S	N
Graduate teaching assistants	A	M	S	N
Undergraduate teaching assistants	A	M	S	N
Group projects	A	M	S	N
Independent projects	A	M	S	N
Extensive lecturing	A	M	S	N
Multiple drafts of written work	A	M	S	N
Readings on racial and ethnic issues	A	M	S	N
Readings on women and gender issues	A	M	S	N
Student-developed activities (assignments, exams, etc.)	A	M	S	N
Student-selected topics for course content	A	M	S	N

33. Please indicate your agreement with each of the following statements.

(Mark one for each item)

	Agree Strongly	Agree Somewhat	Disagree Somewhat	Disagree Strongly
The death penalty should be abolished	4	3	2	1
A national health care plan is needed to cover everybody's medical costs	4	3	2	1
Abortion should be legalized	4	3	2	1
Grading in colleges has become too easy	4	3	2	1
Wealthy people should pay a larger share of taxes than they do now	4	3	2	1
College officials have the right to ban persons with extreme views from speaking on campus	4	3	2	1
The chief benefit of a college education is that it increases one's earning power	4	3	2	1
Racial discrimination is no longer a problem in America	4	3	2	1
Colleges should be actively involved in solving social problems	4	3	2	1
Faculty unionization has enhanced the teaching/learning process	4	3	2	1
Tenure is an outmoded concept	4	3	2	1

34. Indicate the importance to you personally of each of the following:

(Mark one for each item)

	Essential	Very Important	Somewhat Important	Not Important
Becoming an authority in my field	E	V	S	N
Influencing the political structure	E	V	S	N
Influencing social values	E	V	S	N
Raising a family	E	V	S	N
Having administrative responsibility for the work of others	E	V	S	N
Being very well-off financially	E	V	S	N
Helping others who are in difficulty	E	V	S	N
Becoming involved in programs to clean up the environment	E	V	S	N
Developing a meaningful philosophy of life	E	V	S	N
Helping to promote racial understanding	E	V	S	N
Obtaining recognition from my colleagues for contributions to my special field	E	V	S	N

ADDITIONAL QUESTIONS: If you received additional questions, mark answers below:

35. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
36. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
37. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
38. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
39. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
40. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
41. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
42. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
43. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ
44. Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

**Please return your completed questionnaire
in the postage-paid envelope to:
Higher Education Research Institute
2905 West Service Road, Eagan, MN 55121**

**THANK
YOU!**

3153 Questar 576 54321

Appendix B

Definition of Major & Career Field Groupings

Definition of major field groupings

Pure categories

Biological sciences

Biology (general)
Biochemistry or Biophysics
Botany
Marine (life) science
Microbiology or bacteriology
Zoology
Other biological science
Premed, predent., prevet.
Pharmacy
Agriculture
Forestry

Engineering

Aero/astronautical engineering
Civil engineering
Chemical engineering
Electrical engineering
Industrial engineering
Mechanical engineering
Other engineering

Physical sciences

Astronomy
Atmospheric science (including meteorology)
Chemistry
Computer science
Earth science
Marine science (including oceanography)
Mathematics
Physics
Statistics
Other physical science

Other social sciences

Anthropology
Economics
Geography
Political science (inc. gov't, int'l relations)
Sociology
Other social science

Psychology

Combined categories

Natural science (Biological plus Physical science)

Biology (general)
Biochemistry or Biophysics
Botany
Marine (life) science
Microbiology or bacteriology
Zoology
Other biological science
Premed, predent., prevet.
Pharmacy
Agriculture
Forestry

Astronomy
Atmospheric science (including meteorology)
Chemistry
Computer science
Earth science
Marine science (including oceanography)
Mathematics
Physics
Statistics
Other physical science

Science and engineering I (Natural science plus Engineering)

Biology (general)
Biochemistry or Biophysics
Botany
Marine (life) science
Microbiology or bacteriology
Zoology
Other biological science
Premed, predent., prevet.
Pharmacy
Agriculture
Forestry
Engineering

Astronomy
Atmospheric science (including meteorology)
Chemistry
Computer science
Earth science
Marine science (including oceanography)
Mathematics
Physics
Statistics
Other physical science

Science and engineering II (Natural science, Engineering, Psychology, and Other Social Science)

Biology (general)
Biochemistry or Biophysics
Botany
Marine (life) science
Microbiology or bacteriology
Zoology
Other biological science
Premed, predent., prevet.
Pharmacy
Agriculture
Forestry
Engineering
Anthropology
Economics
Psychology

Astronomy
Atmospheric science (including meteorology)
Chemistry
Computer science
Earth science
Marine science (including oceanography)
Mathematics
Physics
Statistics
Other physical science
Geography
Political science (inc. gov't, int'l relations)
Sociology
Other social science

Definition of career field groupings

Engineer

Scientist/College Teacher

Research scientist
Statistician
Conservationist/forester
College teachers with final majors in Biological science, Physical science, or Engineering

Social Scientist/College Teacher

Research scientist
Statistician
Conservationist/forester
College teachers with final majors in Biological science, Physical science, or Engineering, Psychology or other social science

Scientist-pracitioner

Clinical psychologist
Dentist
Optometrist
Pharmacist
Physician
Veterinarian

Appendix C

Profiles of Persisters, Defectors, Recruits

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

	ENGINEER			SCIENTIST			PRACTITIONER		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Number of Respondents	742	255	800	199	519	338	690	367	1,168
Year Graduated from High School									
1985	98.5	96.9	98.5	99.0	98.6	98.8	99.6	98.6	99.2
1984	0.5	1.2	1.0	0.5	1.2	0.6	0.0	1.1	0.5
1983	0.4	0.8	0.0	0.0	0.0	0.3	0.1	0.0	0.0
1982 or earlier	0.4	1.2	0.3	0.0	0.2	0.0	0.0	0.0	0.1
H.S. equivalency (G.E.D. test)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
never completed high school	0.1	0.0	0.1	0.5	0.0	0.3	0.3	0.3	0.1
Age on December 31, 1989									
20 or younger	0.0	0.4	0.0	0.5	0.8	0.3	0.4	0.3	0.3
21	2.8	4.7	4.3	7.0	4.5	6.2	5.1	3.0	3.9
22	80.3	77.3	76.1	77.4	77.1	78.4	78.6	79.6	80.4
23	15.5	14.5	18.9	14.6	16.3	13.9	15.6	16.3	15.0
24	0.9	1.6	0.5	0.5	1.2	0.9	0.3	0.5	0.3
25-28	0.4	1.2	0.1	0.0	0.0	0.3	0.0	0.3	0.1
29-33	0.0	0.4	0.1	0.0	0.2	0.0	0.0	0.0	0.0
34-43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44-58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59 or older	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Racial Background (1)									
White/Caucasian	87.2	87.6	85.3	92.0	88.9	88.7	79.4	83.8	87.7
Black/Negro/Afro-American	4.9	4.4	6.5	0.5	4.1	4.2	8.4	8.8	5.2
American Indian	1.5	0.8	0.5	1.5	1.2	0.9	1.3	0.5	1.5
Asian-American/Oriental	6.2	5.6	6.3	7.0	5.6	4.5	9.2	5.2	5.0
Mexican-American/Chicano	0.9	2.8	1.9	1.5	1.0	1.5	2.6	1.4	2.1
Puerto Rican-American	0.3	0.4	0.4	0.0	0.2	0.9	0.3	0.3	0.7
other	1.3	1.6	1.1	2.5	1.4	2.7	2.8	1.9	1.7
Miles from Home to College									
5 or less	5.3	4.0	3.9	3.5	3.3	3.3	3.8	4.7	4.4
6 to 10	6.0	8.0	5.3	8.0	5.0	6.8	5.2	6.6	5.9
11 to 50	22.8	24.7	16.8	16.1	17.1	19.2	21.4	20.9	18.2
51 to 100	15.0	14.7	12.8	9.5	14.8	17.8	14.7	14.9	16.0
101 to 500	35.5	28.7	36.0	38.2	37.5	34.0	35.2	35.3	36.1
more than 500	15.4	19.9	25.3	24.6	22.3	18.9	19.7	17.6	19.4
Marital Status in 1985									
not presently married	99.9	100.0	99.6	100.0	100.0	100.0	99.9	100.0	99.9
married, living with spouse	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
married, not living with spouse	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
in 1989									
not presently married	95.3	94.5	93.4	98.0	92.7	95.6	95.2	95.4	93.7
married, living with spouse	4.6	5.1	6.3	2.0	6.9	4.4	4.7	4.4	6.1
married, not living with spouse	0.1	0.4	0.4	0.0	0.4	0.0	0.1	0.3	0.3

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Average High School Grade									
A or A+	37.8	38.6	30.0	43.7	35.7	31.4	42.8	29.4	29.0
A-	25.8	22.4	24.2	29.1	22.5	26.3	27.7	21.4	21.4
B+	19.8	16.9	22.1	16.1	23.1	24.6	15.3	23.4	23.3
B	10.8	15.4	14.9	7.5	11.8	11.4	10.2	15.4	16.0
B-	3.4	3.9	5.0	2.0	4.9	3.3	2.9	6.3	6.2
C+	2.0	1.2	3.0	1.0	1.2	2.1	0.6	2.5	2.6
C	0.4	1.2	0.6	0.5	0.8	0.9	0.4	1.6	1.4
D	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Average Undergraduate Grade									
A	11.1	10.2	7.5	19.6	16.7	11.0	17.3	14.2	8.7
B+,A-	28.1	31.8	28.2	38.2	36.1	35.0	43.2	38.4	30.9
B	37.2	34.5	36.8	26.1	32.6	38.0	28.9	30.2	38.5
C+,B-	19.7	20.0	22.4	13.1	12.6	12.5	9.3	15.0	18.5
C	3.9	3.1	4.9	3.0	1.9	3.3	1.3	2.2	3.4
C- or less	0.0	0.4	0.1	0.0	0.0	0.3	0.0	0.0	0.1
Degree Aspirations in 1985									
none	0.3	0.9	0.7	0.0	0.6	0.6	0.3	0.6	0.7
vocational certificate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
associate (A.A. or equivalent)	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0
bachelor's (B.A.,B.S.,etc.)	28.5	26.2	21.4	7.5	17.6	9.0	2.5	14.7	7.3
master's (M.A.,M.S.,etc.)	49.8	41.5	51.0	23.0	26.0	36.8	4.6	28.8	10.6
Ph.D. or Ed.D	19.1	21.0	23.6	64.7	28.3	46.1	14.7	31.0	20.3
M.D., D.O., D.D.S. D.V.M	1.2	9.6	1.5	4.8	24.1	6.8	77.8	16.9	59.7
LL.B. or J.D. (law)	0.3	0.4	0.4	0.0	1.9	0.0	0.2	6.0	0.5
B.D. or M.Div. (divinity)	0.2	0.4	0.6	0.0	0.2	0.3	0.0	0.0	0.0
other	0.2	0.0	0.7	0.0	1.3	0.3	0.0	1.6	0.7
Highest Degree Earned by 1989									
none	40.0	41.6	31.3	13.6	20.0	23.1	12.8	24.5	20.2
vocational certificate	0.4	0.4	0.4	0.0	0.4	0.3	0.3	0.8	0.2
associate (A.A. or equivalent)	3.5	6.1	4.1	1.5	2.6	4.8	2.3	5.2	3.8
bachelor's (B.A., B.S., etc.)	55.7	51.0	63.4	82.4	76.0	71.2	82.8	68.3	74.6
master's (M.A., M.S., etc.)	0.3	0.4	0.4	1.5	1.0	0.6	1.2	0.8	0.5
Ph.D. or Ed.D	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
M.D., D.O., D.D.S., D.V.M	0.0	0.0	0.0	0.5	0.0	0.0	0.1	0.0	0.0
J.D. or LL.B. (law)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
B.D. or M.Div. (divinity)	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0	0.0
other	0.1	0.4	0.3	0.0	0.0	0.0	0.1	0.0	0.7
Degree Aspirations in 1989									
none	0.7	0.0	0.3	1.0	0.8	0.0	0.1	0.0	0.4
vocational certificate	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
associate (A.A. or equivalent)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
bachelor's (B.A., B.S., etc.)	24.8	29.0	20.3	4.2	9.6	14.1	4.0	6.7	12.3
master's (M.A., M.S., etc.)	54.8	47.2	47.0	21.4	20.7	36.2	1.9	7.0	41.6
Ph.D. or Ed.D	16.8	21.4	23.6	71.4	65.2	32.0	14.7	37.4	28.8
M.D., D.O., D.D.S., D.V.M	0.6	0.8	2.4	2.1	3.1	7.8	77.1	44.1	2.9
J.D. or LL.B. (law)	1.4	0.8	5.7	0.0	0.4	6.3	0.3	0.8	11.2
B.D. or M.Div. (divinity)	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.3	1.2
other	0.7	0.8	0.6	0.0	0.2	2.7	1.9	3.6	1.4

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Freshman College was Student's									
first choice	72.6	66.7	72.0	77.3	73.6	77.8	71.7	69.0	73.6
second choice	20.5	25.4	21.8	16.2	20.2	16.3	19.0	22.2	18.2
third choice	5.4	5.2	4.6	4.5	4.1	4.1	6.1	6.0	5.7
less than third choice	1.5	2.8	1.6	2.0	2.1	1.8	3.2	2.7	2.5
College Experiences Noted Very Satisfactory or Satisfactory (2)									
science and mathematics courses	85.7	87.1	77.6	90.5	87.3	80.4	82.5	78.3	71.1
humanities courses	64.8	70.3	71.7	81.0	78.8	77.8	83.1	77.6	83.0
social science courses	58.0	61.8	67.9	62.8	65.8	71.5	76.8	78.4	77.9
courses in major field	84.1	86.1	84.4	91.9	88.3	86.6	91.3	86.7	86.3
general education requirements	61.3	65.9	66.4	68.2	69.3	68.2	77.6	71.2	71.7
relevance of coursework to life	50.7	57.4	48.7	60.9	57.2	52.6	63.3	57.5	58.4
overall quality of instruction	74.3	76.1	76.6	87.9	83.1	83.7	86.2	82.6	83.0
lab facilities and equipment	58.3	65.5	68.4	76.3	69.9	75.0	75.0	69.0	68.9
library facilities	66.2	66.0	73.6	72.9	68.3	73.4	68.8	71.1	68.6
computer facilities	74.0	68.8	73.7	81.8	72.6	75.2	73.9	71.4	70.7
oppty for interdisciplin courses	48.0	51.5	56.3	67.3	65.4	63.6	71.0	65.0	65.0
oppty to talk to professors	76.3	81.3	76.6	90.3	85.8	79.9	83.9	83.3	82.3
oppty for extracurr activities	77.8	76.1	79.1	78.2	79.2	81.2	84.7	79.4	77.9
campus social life	57.4	56.7	53.0	57.4	56.7	59.1	62.6	63.8	61.0
regulations on campus life	40.2	47.9	40.8	43.4	48.5	50.9	52.7	49.3	43.7
academic tutoring or assistance	53.8	58.9	60.5	61.5	62.3	57.4	65.7	64.9	61.2
academic advising	38.8	45.2	45.6	57.2	54.4	48.2	55.0	54.3	51.3
career counseling and advising	38.1	42.9	44.1	43.0	44.6	43.2	49.4	47.6	42.6
personal counseling	30.7	37.9	44.4	47.9	48.5	52.8	52.2	53.1	49.3
student housing	53.7	54.1	57.4	56.8	59.0	63.0	59.9	61.5	59.2
financial aid services	46.5	49.0	47.5	54.8	53.2	51.3	48.0	51.7	51.5
contact with faculty and admin	60.1	64.9	64.9	79.8	75.7	68.0	71.8	71.4	71.8
relations with faculty & admin	60.5	66.1	63.6	79.6	75.3	67.4	74.0	72.6	71.9
oppty to attend films,concerts	68.2	71.9	71.9	75.9	78.0	76.3	77.7	77.5	77.3
job placement services	62.5	54.5	51.8	38.7	42.0	43.4	47.6	44.9	43.0
campus health services	56.9	57.4	62.8	53.3	49.9	55.6	51.8	56.7	52.1
overall college experience	81.2	84.2	79.4	88.9	86.8	82.5	87.3	81.7	82.8
Enroll at Freshman College Again									
definitely yes	35.2	33.6	37.2	48.0	40.6	38.1	49.3	41.2	38.0
probably yes	40.4	36.0	33.8	33.8	35.4	34.5	31.9	29.4	32.8
don't know	5.2	4.3	4.6	3.5	5.6	4.2	3.4	2.7	4.6
probably not	14.0	17.0	16.2	9.1	10.8	14.1	10.8	16.2	16.1
definitely not	5.3	9.1	8.3	5.6	7.5	9.0	4.7	10.4	8.5

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Student Took Time Off, Withdrew or Transferred									
no	85.3	75.2	72.9	85.8	79.9	76.6	87.3	73.5	76.1
transferred	9.1	18.4	18.0	9.6	13.3	12.8	8.3	18.0	16.1
withdrew	0.9	2.0	3.3	0.5	2.5	2.4	1.6	1.9	1.9
leave of absence	4.6	4.4	5.8	4.1	4.3	8.3	2.8	6.6	5.9
Reasons Noted as Very Important for Taking Time Off (3)									
reconsider goals & interests	29.4	50.0	47.7	17.9	45.2	40.7	33.7	40.8	46.6
changed career plans	16.4	40.6	41.3	10.7	40.4	28.7	19.3	35.4	37.7
wanted practical experience	27.5	15.6	12.7	27.6	17.5	17.5	19.3	11.3	13.8
didn't "fit in"	13.8	21.9	17.4	14.3	19.4	25.0	19.3	21.6	20.7
was bored with course work	7.4	10.9	13.6	3.6	13.5	21.2	11.4	12.4	13.0
wanted better acad. reputation	18.5	21.9	9.9	10.7	14.3	11.2	19.1	15.5	15.6
wanted better social life	8.3	9.4	14.2	7.1	15.4	10.0	13.6	12.5	14.2
wanted to be closer to home	3.7	4.7	8.0	13.8	6.7	12.5	4.5	13.4	12.7
had good job offer	8.6	9.4	7.5	10.7	3.8	2.5	4.5	3.1	3.3
wasn't doing well academically	23.4	10.9	25.7	14.3	14.4	27.5	18.2	16.3	18.1
family responsibilities	4.7	0.0	5.2	0.0	6.7	3.8	10.2	7.1	8.7
tired of being student	6.5	4.7	1.4	3.7	6.7	13.9	4.5	6.2	6.9
couldn't afford college	15.9	10.9	11.3	10.7	13.3	24.1	19.3	10.4	14.1
wanted wider course selection	27.1	32.8	22.1	31.0	34.3	22.8	23.6	27.8	27.7
ENROLLMENT STATUS									
First Year									
attended first college full-time	99.0	98.8	99.2	99.5	98.8	99.4	99.7	99.4	99.5
attended first college part-time	0.6	1.2	0.3	0.5	0.2	0.0	0.3	0.3	0.2
attended diff college full-time	0.4	0.0	0.4	0.0	1.0	0.6	0.0	0.3	0.3
attended diff college part-time	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
not enrolled	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Second Year									
attended first college full-time	93.4	89.3	85.5	92.5	91.1	90.4	94.1	83.0	88.5
attended first college part-time	0.7	2.1	1.9	0.5	0.8	1.6	1.1	2.4	1.1
attended diff college full-time	5.0	5.6	10.6	4.8	6.2	6.1	4.2	10.6	8.9
attended diff college part-time	0.4	1.7	0.9	1.6	0.8	1.0	0.5	2.1	0.9
not enrolled	0.4	1.3	1.1	0.5	1.0	1.0	0.2	1.8	0.6
Third Year									
attended first college full-time	87.4	76.7	80.3	84.7	83.2	79.6	90.2	73.9	80.5
attended first college part-time	2.2	2.5	1.5	1.1	0.6	1.9	0.6	1.8	1.5
attended diff college full-time	9.2	14.8	16.0	12.2	13.3	15.3	7.8	18.8	15.8
attended diff college part-time	0.6	1.3	0.3	0.5	1.7	1.9	1.2	2.4	1.5
not enrolled	0.6	4.7	1.9	1.6	1.2	1.3	0.2	3.0	0.7
Fourth Year									
attended first college full-time	86.1	75.5	81.3	86.7	84.5	83.8	90.6	79.7	81.8
attended first college part-time	2.0	1.7	0.9	1.6	1.2	1.6	0.9	1.5	1.6
attended diff college full-time	10.2	19.0	15.4	9.6	12.0	12.6	7.4	16.3	14.9
attended diff college part-time	0.7	1.7	0.9	1.6	1.4	1.3	0.3	1.2	0.8
not enrolled	1.0	2.1	1.5	0.5	0.8	0.6	0.8	1.2	0.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Have Met or Exceeded Recommended Years of High School Study (4)									
English (4 years)	97.1	97.3	95.9	99.5	95.4	97.5	97.8	97.4	96.9
mathematics (3 years)	99.0	98.2	99.2	97.9	98.0	97.8	97.9	96.0	96.3
foreign language (2 years)	81.3	77.1	85.5	88.5	86.5	86.3	90.1	87.2	86.0
physical science (2 years)	83.1	84.2	79.1	88.0	81.5	82.9	79.8	65.7	70.7
biological science (2 years)	26.6	33.9	25.3	46.9	45.7	53.0	62.1	48.3	57.8
history or Am gov (1 year)	99.0	100.0	99.4	100.0	99.4	99.7	99.7	99.7	99.8
computer science (1/2 year)	79.2	71.2	72.0	66.1	66.0	64.4	62.6	57.3	60.7
art or music (1 year)	53.7	54.1	55.8	56.5	63.6	63.1	60.2	67.8	61.5
Number of Undergraduate Courses Taken Which Emphasize:									
Writing Skills									
none	3.7	2.4	3.4	7.0	2.9	3.0	1.3	2.7	1.1
1 - 2	47.1	39.2	30.3	33.7	34.6	30.8	30.6	30.5	27.6
3 - 5	39.8	43.9	43.4	38.7	41.3	33.1	40.5	38.1	34.4
6 - 8	6.8	11.0	11.5	14.1	9.7	13.3	12.8	13.1	15.3
9 or more	2.7	3.5	11.4	6.5	11.6	19.8	14.8	15.5	21.6
Math/Understanding Numbers									
none	0.0	0.4	0.3	1.0	0.6	1.2	1.5	1.6	1.5
1 - 2	0.3	1.6	5.9	8.5	13.9	23.4	25.6	30.2	31.0
3 - 5	10.7	11.8	28.8	38.2	37.1	32.5	46.5	47.1	43.4
6 - 8	26.6	25.1	25.0	16.1	17.2	13.3	13.7	12.3	12.6
9 or more	62.5	61.2	40.1	36.2	31.3	29.6	12.8	8.7	11.6
Science/Scientific Inquiry									
none	0.3	0.4	0.3	0.5	0.4	0.0	0.3	0.8	0.7
1 - 2	1.8	4.7	10.8	0.0	6.2	12.4	2.8	11.7	19.6
3 - 5	10.3	14.5	29.8	3.5	8.5	24.0	5.7	18.5	30.4
6 - 8	20.7	18.0	18.5	4.0	9.5	12.1	9.0	15.0	11.9
9 or more	66.9	62.4	40.7	92.0	75.5	51.5	82.3	54.0	37.4
History/Historical Analysis									
none	19.5	18.0	9.3	11.1	10.6	10.4	11.9	8.5	5.6
1 - 2	51.3	46.7	42.2	46.2	54.5	42.1	50.4	48.1	46.0
3 - 5	26.6	31.4	36.9	37.7	30.4	33.5	31.0	37.2	33.5
6 - 8	2.2	2.7	7.8	4.5	3.7	8.0	4.1	4.4	8.5
9 or more	0.4	1.2	3.9	0.5	0.8	5.9	2.6	1.9	6.4
Foreign Language Skills									
none	78.9	65.5	53.7	33.7	40.6	35.4	32.9	33.2	36.1
1 - 2	14.1	22.7	27.9	38.2	33.3	34.5	35.7	36.5	32.3
3 - 5	5.5	9.4	13.5	23.6	20.3	22.9	25.1	22.3	22.1
6 - 8	1.1	2.0	3.1	3.0	3.1	5.4	3.9	4.6	5.8
9 or more	0.4	0.4	1.8	1.5	2.7	1.8	2.3	3.3	3.7

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Events Considered Very Likely to Occur (in 1985)									
be elected to student office	1.8	3.2	3.3	1.6	2.4	3.4	5.7	4.3	5.5
be satisfied with college	56.3	56.1	62.1	61.4	65.6	69.1	73.8	60.7	69.2
change career choice	5.5	27.9	12.5	11.1	24.0	20.9	4.4	26.9	10.7
change major field	6.5	25.3	12.0	8.5	21.6	15.1	6.5	27.9	10.9
drop out permanently	0.1	1.4	0.1	0.0	0.0	0.0	0.2	0.9	0.4
drop out temporarily	0.3	0.9	0.5	0.0	0.0	0.6	0.5	1.2	0.7
get job to pay expenses	42.0	44.3	40.9	50.3	45.0	48.3	38.3	43.3	40.8
get married while in college	2.4	6.0	1.2	1.1	1.2	3.1	3.3	3.1	3.8
graduate with honors	22.9	24.4	18.3	22.8	22.7	19.1	30.6	18.1	21.4
join social frat or sorority	18.6	21.6	20.6	18.5	19.7	22.0	26.7	26.0	26.7
make at least "B" average	53.9	53.2	52.3	63.0	59.1	59.7	67.6	54.0	60.0
participate in student protests	3.3	5.1	3.8	7.4	8.3	9.4	5.2	7.2	7.5
play varsity athletics	12.5	20.4	20.6	16.4	17.9	17.3	16.0	16.3	16.8
transfer to another college	8.4	10.6	10.4	6.4	5.0	7.1	4.3	9.2	8.3
work at outside job	14.8	15.2	15.4	15.4	15.1	17.1	14.2	14.9	17.0
work full-time while attending	1.8	2.7	3.6	2.1	0.8	1.2	0.9	1.7	1.8
Events Occurring by 1989									
elected to student office	21.1	26.3	24.4	24.5	20.7	22.2	30.7	22.5	26.0
satisfied with freshman coll (5)	80.6	83.5	79.2	88.4	86.1	82.5	87.0	81.5	82.4
changed career choice (5)	0.0	100.0	100.0	17.1	97.8	97.3	11.6	91.6	92.4
changed major field (5)	5.5	58.1	74.5	19.5	61.2	67.2	55.2	68.2	75.2
dropped out permanently (5)	0.9	2.0	3.2	0.5	2.5	2.4	1.6	1.9	1.9
dropped out temporarily (5)	4.6	4.3	5.7	4.0	4.2	8.3	2.8	6.5	5.8
got part-time job on campus	56.0	60.1	54.2	80.4	75.8	71.3	62.6	62.0	64.8
got married	4.2	5.2	6.3	2.6	6.8	4.5	4.7	4.7	5.7
graduated with honors	27.1	29.3	21.0	45.6	38.9	33.3	40.5	32.5	25.2
joined social frat or sorority	27.6	26.8	22.0	15.7	16.0	27.3	30.9	27.5	28.3
made at least "B" average (5)	76.4	76.5	72.6	83.9	85.4	84.0	89.4	82.8	78.0
participated in student protests	12.7	12.0	19.1	28.1	29.6	28.5	24.2	26.4	25.8
played intercollegiate athletics	24.7	31.5	31.2	26.4	28.4	27.8	29.3	27.0	27.4
transferred before grad (5)	9.0	18.0	17.7	9.5	13.1	12.7	8.3	17.7	15.9
worked part-time job off-campus	49.0	58.6	53.5	42.6	48.7	59.6	59.4	67.5	64.0
worked full-time while student	10.1	17.3	12.5	8.2	6.8	14.2	8.3	10.1	11.9
Other College Activities									
assisted faculty teaching class	13.3	17.9	18.8	43.9	33.1	25.0	27.8	18.9	19.7
attended racial awareness wkshop	13.0	14.8	22.3	25.5	26.0	26.1	34.8	36.7	32.9
enrolled in ethnic stud course	11.6	16.3	22.7	24.7	26.7	31.0	33.4	33.4	36.1
enrolled in honors program	47.6	57.2	48.3	75.1	72.0	60.8	68.9	62.1	54.6
enrolled in interdisc course	54.9	59.0	60.3	70.3	67.1	67.1	68.2	62.5	60.9
enrolled in women's stud course	3.7	6.4	9.4	9.7	15.7	20.5	19.4	25.5	25.0
in college internship program	34.1	30.7	25.2	20.5	20.9	30.7	25.8	31.0	29.8
in study abroad program	2.4	4.8	7.6	15.3	12.7	15.1	12.2	14.0	16.3
played intercoll foot/basketball	5.7	7.6	5.7	2.0	4.5	4.8	4.4	4.1	4.9
purchased a personal computer	30.1	25.4	30.8	17.9	19.9	22.3	24.4	25.2	19.1
taken reading study/skills class	9.6	12.4	12.6	7.1	7.8	13.2	13.5	14.0	16.8
taken remedial/develop course	4.5	6.0	4.6	1.0	2.0	5.7	5.1	8.8	5.7
voted in 1988 election	68.6	68.5	70.6	74.1	71.1	72.6	73.4	72.0	71.1
worked on prof's research proj	25.8	29.6	28.0	68.0	57.7	29.4	49.1	36.2	30.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Activities in the Past Year									
Reported in 1985									
attended recital or concert	75.7	74.6	81.5	83.2	84.9	83.7	86.8	85.4	86.4
drank beer	65.6	56.2	66.0	54.0	59.1	57.9	56.7	64.1	63.5
felt depressed (6)	8.1	7.0	6.8	7.7	9.3	13.1	7.0	11.8	9.2
felt overwhelmed (6)	14.7	15.2	14.3	16.8	15.7	18.7	16.1	22.5	20.9
missed school due to illness (6)	1.2	2.1	2.3	3.6	2.3	3.3	4.1	2.7	4.9
smoked cigarettes (6)	1.2	2.0	2.3	3.0	4.7	2.7	2.3	5.5	5.3
stayed up all night	67.2	66.4	68.5	59.4	66.6	72.0	71.9	74.1	74.7
tutored another student	66.8	60.8	67.0	67.9	65.7	69.2	70.7	65.5	62.5
was guest in teacher's home	27.7	35.0	35.1	41.9	39.8	38.9	35.9	34.9	41.6
Reported in 1989									
attended recital or concert	65.7	67.5	71.3	73.7	78.3	79.2	80.0	78.1	75.4
didn't complete homework on time	65.6	57.3	59.7	55.1	48.2	53.1	39.3	41.4	49.9
discuss course content w/std (6)	68.1	70.4	60.6	67.0	64.0	65.2	62.5	65.3	59.8
discuss political/soc issues (6)	22.1	26.1	36.1	37.4	42.4	45.7	39.5	43.0	44.0
discuss racial/ethnic issues (6)	6.4	5.9	10.2	10.6	13.2	16.9	16.8	17.0	19.1
drank beer	78.9	71.4	78.3	71.7	72.3	70.2	71.4	72.3	73.5
drank wine or liquor	76.2	69.8	77.9	76.8	76.4	79.5	79.1	81.1	82.2
felt depressed (6)	11.9	12.3	11.6	10.6	13.5	15.4	11.5	14.5	11.9
felt like leaving college	26.4	25.3	30.9	23.2	27.3	33.3	18.7	25.6	30.2
felt overwhelmed (6)	35.2	32.8	31.9	27.8	31.9	32.9	26.7	29.6	32.7
gave a presentation in class (6)	10.3	12.6	17.0	14.6	12.2	20.8	12.4	12.9	19.8
missed class due to illness (6)	0.5	1.6	1.6	0.5	1.5	1.8	1.6	1.4	1.5
paper critiqued by instructor(6)	16.4	21.1	36.7	28.3	36.2	42.1	38.1	42.2	46.4
participated in intramural sport	59.0	53.4	60.0	45.5	44.8	44.5	51.0	41.9	43.5
read the student newspaper (6)	57.2	62.1	56.7	60.1	62.7	64.7	65.1	63.8	63.8
received personal counseling	5.1	7.5	13.5	8.1	15.3	14.2	15.5	20.0	15.8
received tutoring in courses	22.5	22.1	24.5	12.1	14.9	14.5	18.9	15.7	18.3
received vocational counseling	48.6	46.6	56.0	52.0	58.7	57.0	56.0	61.1	57.1
smoked cigarettes (6)	2.0	3.2	3.6	4.5	6.2	6.2	3.8	6.6	8.1
social with diff ethnic grp (6)	36.8	41.5	42.8	48.5	44.4	50.4	56.1	44.9	47.3
stayed up all night	64.6	70.2	65.4	61.1	57.6	65.6	59.9	56.7	63.5
took a multiple-choice exam (6)	14.4	15.1	43.2	18.2	23.0	33.8	48.4	51.5	45.7
took an essay exam (6)	14.4	17.8	43.9	43.4	46.6	54.9	57.2	57.8	59.5
took pt in campus demonstration	9.6	11.5	16.0	20.7	23.4	22.0	19.7	20.5	21.4
tutored another student	63.6	70.8	65.6	66.2	67.2	63.5	65.7	62.7	57.5
was guest in professor's home	19.4	20.6	32.0	51.5	48.2	35.9	43.6	39.7	41.6
worked on grp proj for class (6)	50.3	44.3	35.6	14.1	18.9	21.4	17.0	18.1	24.6
worked on ind research project	53.9	50.0	55.7	70.2	72.5	55.8	61.0	57.3	60.0

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Student Rated Self Above Average or Highest 10%									
in 1985									
academic ability	94.1	86.7	92.4	94.4	92.3	91.4	92.5	81.3	87.1
artistic ability	27.8	32.4	23.1	29.8	27.7	27.7	30.2	25.1	25.5
drive to achieve	79.8	74.8	81.2	87.8	77.9	78.9	89.7	75.6	79.9
emotional health	63.6	67.8	68.8	63.6	62.6	59.4	72.1	60.5	66.1
leadership ability	57.9	58.9	61.8	58.1	54.4	56.5	65.9	58.0	62.0
mathematical ability	91.4	85.5	85.6	78.7	71.5	72.9	73.0	57.9	56.8
physical health	69.8	68.9	68.2	57.1	60.9	61.0	66.2	61.2	62.8
popularity	34.4	42.5	44.0	28.9	33.3	33.3	48.8	40.8	47.3
self-confidence (intellectual)	72.5	75.9	72.8	81.2	74.4	75.2	79.7	65.2	71.3
self-confidence (social)	38.5	40.8	45.7	31.3	36.8	38.1	51.4	43.0	49.4
writing ability	43.5	49.6	51.9	62.1	59.0	55.7	60.7	52.9	55.4
in 1989									
academic ability	88.8	89.4	90.1	92.0	93.1	88.1	93.3	88.5	85.4
artistic ability	28.1	34.9	27.0	30.7	29.2	32.9	33.3	27.0	29.9
drive to achieve	76.6	78.7	76.4	74.9	76.0	71.4	88.4	79.0	76.3
emotional health	58.6	62.7	63.6	57.8	56.9	54.0	68.0	61.5	61.6
leadership ability	63.6	66.7	70.7	54.3	53.8	60.8	69.3	59.8	65.9
mathematical ability	92.2	91.4	79.6	76.9	75.4	59.9	66.3	53.4	49.5
physical health	62.3	69.0	66.2	59.8	59.4	54.6	63.5	57.1	58.1
popularity	37.9	44.3	46.7	32.7	36.4	37.3	52.3	43.3	48.7
self-confidence (intellectual)	76.1	79.6	77.7	81.4	74.9	75.1	80.0	77.0	76.2
self-confidence (social)	42.9	44.7	52.9	37.9	42.5	47.3	58.0	50.0	56.2
writing ability	50.3	63.1	59.7	65.8	66.0	70.0	66.6	60.7	66.2
listening ability	63.6	71.8	71.0	71.4	79.0	76.9	82.0	83.6	81.4
Students Reporting Much Stronger Abilities and Skills in 1989									
general knowledge	46.5	49.4	52.2	44.2	55.4	50.9	58.4	56.7	55.8
problem-solving skills	59.2	59.6	41.1	43.7	49.7	39.1	41.4	36.9	35.8
knowledge of particular field	70.1	74.0	63.7	80.9	75.3	72.2	75.9	73.8	69.2
critical thinking ability	39.7	40.5	40.7	42.2	46.6	41.5	45.5	40.4	43.8
writing skills	12.0	15.3	18.1	14.1	21.0	28.1	21.6	20.7	27.8
foreign language ability	1.9	5.5	8.1	6.5	9.1	9.8	10.3	10.1	11.5
job-related skills	39.5	41.3	32.3	25.0	26.5	29.9	20.0	19.4	25.9
religious beliefs & convictions	8.2	7.8	12.4	8.1	9.9	7.7	11.4	10.6	11.3
interest in grad/prof school	25.0	29.8	28.7	31.7	46.6	35.0	45.9	58.6	38.7
preparation for grad/prof school	27.0	26.8	27.0	47.7	47.8	35.2	53.6	50.5	35.2
leadership abilities	25.5	25.5	33.3	19.1	22.5	30.2	30.0	24.9	30.0
ability to work independently	28.0	31.8	35.2	32.2	38.3	35.2	37.0	33.5	40.3
interpersonal skills	27.2	29.8	32.4	22.6	30.4	33.7	37.2	32.3	37.5
cultural awareness	18.2	26.3	27.6	26.1	30.4	36.7	39.2	36.3	38.1
acceptance of dif races/cultures	15.3	20.0	21.1	19.1	24.5	26.6	28.6	26.8	28.8
competitiveness	16.2	18.0	21.0	6.0	9.5	14.2	14.3	14.4	14.4
confidence in academic abilities	23.4	26.7	24.9	16.6	24.1	23.7	25.9	26.7	24.4
public speaking ability	17.4	19.2	22.7	14.1	17.2	21.6	18.4	16.6	19.8
ability to work cooperatively	18.9	19.6	19.9	11.6	17.4	18.9	18.6	18.0	22.4

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
LIVING ARRANGEMENTS									
Preferred for Fall 1985									
with parents or relatives	13.5	16.1	10.9	10.9	11.6	9.0	9.5	7.2	10.2
other private home,apt,room	19.3	18.3	19.5	11.4	13.4	14.5	17.2	21.6	15.5
college dormitory	54.6	50.9	58.8	67.4	68.0	67.7	65.1	58.8	63.2
fraternity or sorority house	5.9	6.4	5.2	2.9	2.0	2.6	3.3	7.8	6.7
other campus housing	5.9	6.4	4.7	7.4	4.3	5.5	4.5	3.9	3.5
other	0.8	1.8	0.9	0.0	0.7	0.6	0.3	0.7	0.9
Planned for Fall 1985									
with parents or relatives	18.9	18.4	14.6	9.5	12.7	12.4	13.5	16.2	14.2
other private home,apt,room	1.4	2.8	1.4	1.5	0.8	1.2	1.6	0.6	1.1
college dormitory	77.7	73.2	81.1	84.9	83.8	83.0	82.6	81.0	82.9
fraternity or sorority house	0.3	0.4	0.9	0.0	0.2	0.0	0.3	0.3	0.2
other campus housing	1.6	5.2	1.8	2.0	2.3	3.0	1.6	1.4	1.4
other	0.1	0.0	0.3	2.0	0.2	0.3	0.4	0.6	0.2
First Year									
with parents or relatives	17.8	18.7	15.8	9.1	11.5	13.2	13.8	14.7	13.7
other private home,apt,room	1.0	2.4	2.3	2.0	2.0	1.5	2.5	2.0	1.5
college dormitory	78.1	74.9	79.5	86.3	84.3	82.9	81.4	81.4	83.2
frat or sorority house	1.7	1.2	0.9	1.0	0.4	0.6	0.7	0.3	0.2
other campus student housing	1.4	2.4	1.3	1.5	1.6	1.8	1.5	1.4	1.3
other	0.1	0.4	0.3	0.0	0.2	0.0	0.0	0.3	0.2
Second Year									
with parents or relatives	17.4	17.3	17.7	10.3	12.8	13.2	13.6	16.1	13.8
other private home,apt,room	9.7	12.0	10.3	9.7	11.4	9.5	14.3	15.0	14.3
college dormitory	59.0	55.8	62.6	69.7	65.7	65.0	59.9	60.4	59.8
frat or sorority house	8.6	8.4	6.0	3.6	3.4	4.9	4.8	2.1	5.1
other campus student housing	5.0	5.6	2.8	6.7	6.0	7.1	6.9	6.2	6.3
other	0.3	0.8	0.5	0.0	0.8	0.3	0.4	0.3	0.7
Third Year									
with parents or relatives	14.8	16.3	14.0	9.8	11.4	12.2	14.3	15.2	13.4
other private home,apt,room	28.9	24.0	28.7	23.7	27.8	25.5	26.5	33.0	29.8
college dormitory	36.4	39.4	44.3	49.0	48.5	42.2	43.9	41.5	41.5
frat or sorority house	11.1	9.3	6.8	6.7	3.7	7.3	5.2	2.9	6.1
other campus student housing	8.4	8.1	5.4	9.8	7.5	10.6	9.4	7.4	7.7
other	0.4	2.8	0.9	1.0	1.0	2.1	0.7	0.0	1.5
Fourth Year									
with parents or relatives	13.4	16.0	14.5	9.7	12.2	13.3	16.6	16.3	14.9
other private home,apt,room	40.7	37.0	36.7	33.8	37.7	32.8	34.2	39.2	38.7
college dormitory	26.8	28.8	35.8	37.9	37.9	33.1	31.8	29.7	31.4
frat or sorority house	9.3	9.9	5.5	5.1	3.2	6.8	5.2	4.1	5.4
other campus student housing	8.2	6.6	6.4	12.8	7.4	13.0	11.5	10.2	7.7
other	1.7	1.6	1.2	0.5	1.6	0.9	0.7	0.6	1.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
College Attributes Noted as Very Descriptive									
easy to see fac outside off hrs	31.1	33.5	36.1	52.3	51.6	41.4	45.0	47.3	44.3
great conformity among students	22.0	28.1	32.9	20.1	25.6	26.6	23.3	26.5	27.8
most students very bright	39.1	46.1	47.8	43.7	37.4	47.0	48.8	48.1	41.3
admin open about policies	13.1	15.9	16.0	11.1	14.1	13.9	13.7	16.4	13.3
keen competition for grades	42.2	39.8	41.9	33.2	26.6	31.7	34.0	30.6	32.8
courses more theoret than prac	36.5	31.6	31.2	25.1	25.2	28.4	22.1	23.3	24.7
fac rewarded for advising skills	4.9	4.9	6.1	5.1	5.1	7.5	6.7	7.1	5.6
little std contact out of class	5.4	4.8	4.9	3.0	3.3	5.6	3.2	7.2	5.0
faculty at odds with admin	4.6	4.5	5.1	8.2	7.7	7.8	5.3	6.7	6.0
intercoll sports overemphasized	7.3	4.7	11.3	9.5	8.2	9.2	8.5	8.2	9.9
classes usually informal	25.3	25.2	22.4	36.4	29.8	29.9	28.3	30.6	32.2
faculty respect each other	36.7	43.6	44.3	47.5	52.9	49.6	49.6	52.1	49.9
most stdnts treated like numbers	15.0	12.6	18.6	8.0	8.3	10.1	8.2	10.1	11.0
social activities overemphasized	4.2	8.4	5.8	9.6	6.8	6.5	4.2	6.0	7.2
little contact between students	6.9	3.6	6.4	2.0	3.3	2.7	3.2	3.0	4.1
student body apathetic	27.7	23.6	22.3	27.1	20.4	21.0	19.5	21.1	19.6
stdnts don't socialize regularly	3.0	3.5	3.0	2.0	1.0	1.5	1.9	2.2	3.3
fac rewarded for good teaching	12.5	12.0	12.6	15.8	16.9	15.9	18.1	19.2	18.1
Plans for Fall 1989									
attend college full-time	45.3	52.2	37.2	16.1	22.0	27.8	15.4	31.9	27.5
attend college part-time	2.3	4.3	3.4	1.5	3.3	3.8	4.1	3.0	3.3
attend graduate school	15.6	17.6	17.1	58.8	43.2	23.7	61.6	41.1	25.2
attend vocational program	1.1	0.0	1.0	0.0	0.0	0.0	0.4	0.0	0.4
work full-time	41.8	29.8	42.1	24.6	34.1	50.0	22.9	27.0	46.3
work part-time	17.7	25.9	22.0	17.6	19.5	21.6	15.4	27.0	24.1
serve in Armed Forces	2.8	2.7	14.6	1.0	1.2	4.1	1.9	1.6	1.3
travel	2.2	3.1	2.9	5.0	3.9	3.8	3.9	1.6	5.5
do volunteer work	4.3	3.1	4.5	4.5	7.3	8.3	10.9	15.8	9.2
stay at home	2.8	4.3	3.4	2.0	3.9	4.1	2.6	2.7	5.1
Permission to Use I.D. in 1985									
yes	84.6	84.5	83.6	81.0	81.6	81.9	82.1	82.0	83.4
no	15.4	15.5	16.4	19.0	18.4	18.1	17.9	18.0	16.6
in 1989									
yes	71.3	79.8	72.3	76.4	81.4	77.0	75.0	75.8	75.9
no	28.7	20.2	27.7	23.6	18.6	23.0	25.0	24.2	24.1

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Personal Objectives Noted as Very Important or Essential									
in 1985									
achieve in a performing art	5.5	11.0	7.2	13.2	10.5	11.3	10.8	14.5	9.6
be expert on finance/commerce	14.7	21.9	17.6	2.6	11.6	8.6	9.3	16.2	10.5
be involved in environ cleanup	21.9	21.1	19.1	37.2	29.1	34.5	21.4	21.6	21.2
be successful in own business	36.9	38.6	36.4	12.7	29.5	23.0	52.8	42.2	50.6
be very well off financially	70.6	66.2	70.1	42.3	50.9	50.2	63.0	59.4	62.0
become authority in my field	68.6	73.7	73.5	76.4	73.6	77.7	76.2	71.5	74.7
create artistic work	6.4	11.9	5.7	8.9	10.0	8.9	7.8	10.9	8.0
develop philosophy of life	42.4	45.4	48.5	52.1	57.3	52.3	56.2	57.6	53.9
have admin responsibility	38.1	36.5	41.1	18.4	25.8	24.8	30.2	35.8	31.8
help others in difficulty	48.8	53.2	54.9	54.7	61.0	64.3	80.2	73.7	79.5
influence political structure	10.9	11.9	14.8	10.1	11.8	13.4	13.2	13.1	13.1
influence social values	21.3	25.2	24.5	17.4	25.3	23.1	31.0	31.1	34.3
obtain recog from colleagues	55.8	59.8	56.0	60.5	56.7	60.8	62.2	52.7	59.3
participate in community action	16.5	17.0	20.4	16.9	23.6	26.5	30.4	22.9	30.0
promote racial understanding	25.2	30.7	34.2	35.8	37.1	41.5	42.5	41.4	40.3
raise a family	68.5	66.4	72.9	55.9	62.5	61.7	74.7	73.2	72.3
theoretical contrib to science	32.3	32.9	32.1	70.5	36.1	62.2	36.3	24.2	34.2
write original works	6.1	8.2	8.5	15.8	13.5	17.5	10.7	16.0	11.4
in 1989									
achieve in a performing art	6.9	8.3	7.2	6.5	6.6	11.0	9.6	8.7	9.0
be expert on finance/commerce	15.0	15.0	25.9	4.0	5.8	10.9	5.8	4.4	17.0
be involved in environ cleanup	33.6	36.6	33.5	49.2	56.4	51.2	37.1	39.5	40.1
be successful in own business	31.0	40.6	40.4	10.6	15.3	26.7	43.7	40.4	32.2
be very well off financially	61.4	64.4	57.8	32.2	36.8	45.3	48.8	50.5	54.7
become authority in my field	65.4	69.3	67.0	69.8	76.3	62.4	72.6	74.6	67.3
create artistic work	7.2	10.6	10.7	9.5	11.2	10.4	8.7	11.2	13.3
develop philosophy of life	48.8	50.0	51.7	56.6	60.0	58.2	63.7	65.2	60.0
have admin responsibility	46.8	46.6	49.7	23.1	24.8	35.6	30.5	34.0	42.4
help others in difficulty	53.1	56.3	60.4	49.7	61.5	65.7	85.4	86.3	74.3
influence political structure	12.6	15.4	20.6	12.1	17.2	21.0	17.4	17.8	23.8
influence social values	29.2	30.4	37.6	31.2	39.5	45.0	49.1	52.6	54.1
obtain recog from colleagues	49.5	57.7	46.7	62.3	59.2	55.3	56.2	55.7	51.3
participate in community action	21.2	20.9	26.1	21.7	29.9	28.9	43.8	39.3	39.4
promote racial understanding	24.8	27.6	30.2	33.7	37.8	38.5	46.3	46.8	46.8
raise a family	68.6	67.6	69.0	52.5	61.6	62.1	72.5	74.0	70.8
theoretical contrib to science	27.0	35.8	15.1	70.4	60.5	24.9	37.6	34.8	19.8
write original works	7.2	9.4	12.2	13.6	15.6	18.3	12.8	12.6	16.5

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Political Orientation in 1985									
far left	1.7	1.8	0.8	2.0	3.6	2.1	0.9	1.1	1.6
liberal	21.0	20.6	21.7	33.0	29.4	28.5	25.4	28.7	27.9
middle of the road	47.3	45.2	47.1	39.1	44.1	46.7	46.3	51.3	45.8
conservative	28.6	29.8	29.0	23.9	22.3	20.9	26.1	18.0	23.5
far right	1.5	2.6	1.4	2.0	0.6	1.8	1.3	0.8	1.1
in 1989									
far left	0.7	0.4	1.1	3.1	4.1	2.7	2.3	1.4	3.1
liberal	18.3	23.8	23.9	39.8	40.6	34.8	35.7	37.5	34.5
middle of the road	40.8	36.1	37.4	36.7	34.4	33.6	35.4	38.1	37.4
conservative	38.6	37.7	36.4	19.4	20.2	27.3	26.2	22.7	24.5
far right	1.6	2.0	1.3	1.0	0.8	1.5	0.3	0.3	0.5
Agrees Strongly/Somewhat in 1985									
abolish death penalty	20.4	21.3	23.0	28.9	29.0	29.4	29.6	34.2	30.0
abortion should be legalized	54.2	56.9	56.6	62.6	64.1	61.4	58.1	61.2	58.5
busing OK to achieve balance	37.4	46.3	42.6	47.4	50.0	46.6	48.8	51.3	50.8
college ban extreme speakers	20.8	21.9	21.2	16.2	18.3	15.2	17.2	18.9	19.5
college raises earning power	71.3	68.0	66.7	51.3	52.1	56.4	54.8	50.7	56.8
college regulate off-campus acts	12.0	15.1	9.4	11.5	10.8	12.6	11.3	12.6	11.1
equal opportunity for women	92.4	91.8	93.9	95.3	95.8	97.0	95.2	96.0	95.4
gov't not controlling pollution	79.3	77.5	77.7	84.2	85.6	84.5	82.4	81.6	81.9
gov't not promoting disarmament	62.7	60.4	58.6	73.3	72.7	72.7	71.5	76.1	75.6
high school grading too easy	58.2	68.3	61.3	71.4	60.8	67.9	59.0	56.8	55.0
ind can do little to change soc	35.2	34.4	31.2	34.6	30.7	28.7	31.6	23.9	31.5
marijuana should be legalized	15.6	19.6	17.0	14.7	19.7	21.8	14.3	20.3	19.0
married women best at home	21.6	21.9	18.7	12.6	12.0	10.9	12.8	16.3	11.9
national health care plan needed	50.3	42.6	48.8	57.4	53.6	54.6	51.1	59.4	53.9
raise taxes to reduce deficit	29.9	34.9	27.5	39.5	33.5	32.8	26.5	24.1	26.1
wealthy should pay more taxes	79.4	75.3	74.9	80.1	79.9	78.2	71.9	73.1	72.5
in 1989									
abolish death penalty	19.1	18.4	22.7	36.0	33.3	31.3	31.6	31.6	29.2
abortion should be legalized	69.2	67.7	69.6	77.4	78.1	77.2	72.5	77.7	75.8
busing OK to achieve balance	39.5	40.0	41.4	46.7	52.9	44.3	48.6	48.8	52.1
coll ban extreme speakers	18.0	19.0	16.7	12.6	13.2	11.7	12.4	12.0	12.3
coll involvement in social pgms	70.5	73.2	74.6	82.8	83.4	75.2	85.7	85.8	83.1
coll regulate off-campus acts	8.6	9.6	13.3	9.5	8.1	10.5	12.4	10.7	7.9
college raises earning power	49.3	50.8	43.3	29.6	30.8	36.7	30.6	33.1	38.0
control AIDS w/mandatory testing	35.3	30.0	32.5	25.6	23.6	30.7	28.0	31.2	28.0
equal opportunity for women	94.9	97.6	96.5	98.5	97.1	97.9	96.8	96.7	97.3
gov't not controlling pollution	87.2	83.0	86.7	98.0	94.0	91.9	94.5	95.9	92.2
gov't not promoting disarmament	51.9	48.8	50.1	67.8	76.0	71.0	74.0	74.9	75.0
grading in college too easy	31.3	30.2	31.1	40.8	38.0	39.0	30.8	34.7	32.1
ind can do little to change soc	39.3	34.9	32.3	37.7	29.6	32.1	24.9	24.0	27.1
man not entitled to sex on date	91.9	96.8	94.3	95.5	95.9	96.4	96.8	95.4	96.3
marijuana should be legalized	16.3	18.1	22.9	25.1	28.6	25.5	20.4	20.3	23.3
married women best at home	12.5	12.0	10.2	5.5	4.3	7.2	4.4	6.3	6.0
national health care plan needed	56.2	49.6	54.2	67.3	67.8	68.2	64.1	73.2	65.0
racial discrim no longer problem	16.8	19.8	14.3	11.1	8.5	9.0	5.4	7.4	9.1
raise taxes to reduce deficit	35.4	30.3	34.0	43.7	46.1	39.4	34.8	30.6	35.4
wealthy should pay more taxes	72.1	70.0	73.2	82.3	80.2	80.0	71.9	73.9	73.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Agrees Strongly or Somewhat									
a lot of racial conflict here	18.4	18.8	21.9	18.8	20.6	19.8	25.5	26.5	25.5
admin care little about students	38.4	33.9	35.7	39.0	31.4	31.4	28.0	27.5	29.7
admin considers faculty concerns	68.2	74.3	69.5	65.8	70.3	69.7	73.5	69.0	68.6
admin considers student concerns	42.5	46.4	42.8	42.9	51.3	49.5	50.2	45.8	47.1
courses incl feminist perspectve	28.0	31.0	36.9	46.4	49.4	47.3	50.8	47.9	47.8
courses incl minority perspectve	28.8	42.0	34.1	42.9	44.0	48.5	48.0	45.4	48.1
curriculum over-specialized	26.5	24.3	25.4	21.0	18.2	21.1	18.3	20.4	20.4
ethnic groups communicate well	67.6	69.6	67.1	71.1	69.9	69.1	69.4	70.2	67.1
fac committed to welfare of coll	69.7	72.6	70.3	79.0	76.0	78.1	78.2	78.6	77.4
fac feels students well-prepared	77.7	69.0	76.0	78.4	76.9	75.5	83.4	77.0	75.9
fac interested in acad problems	65.4	58.1	67.2	82.7	80.5	72.5	76.6	73.7	74.5
fac interested in student probs	44.9	48.0	53.4	72.1	70.4	64.2	65.5	66.5	64.7
fac positive about gen ed pgm	84.0	86.3	84.3	88.5	88.0	86.9	88.5	90.8	88.0
fac sensitive to minority issues	60.5	68.9	66.3	71.5	76.1	71.9	70.3	73.1	72.7
low trust btwn minorities/admin	27.5	30.0	27.0	33.7	32.1	32.5	30.9	30.5	30.0
many students don't "fit in"	31.1	33.5	32.2	28.1	29.6	35.5	33.1	32.7	33.2
oppty for fac/stdnt socializing	40.8	49.6	40.8	56.9	58.6	48.1	56.6	50.3	53.6
students resent required courses	58.1	55.1	53.2	57.9	51.6	49.8	46.6	50.1	49.8
Objectives Rated as High or Highest Priorities for College									
allow airing of diff opinions	36.3	40.7	38.6	50.5	50.0	49.8	50.4	49.2	50.4
conduct basic & applied research	66.4	66.0	56.1	56.8	54.2	54.7	56.0	54.5	53.1
create multi-cultural environ	29.3	32.4	31.1	35.4	41.6	39.8	44.2	45.3	43.7
create positive undergrad exp	61.7	56.3	60.0	66.3	73.2	65.9	72.3	70.5	73.4
devel apprec of multi-cultul soc	25.8	33.3	30.0	38.9	40.4	43.7	46.9	44.9	46.8
devel community among fac/stdnts	24.3	29.1	32.0	37.2	43.5	39.0	48.0	44.5	45.9
devel leadership ability in fac	32.0	34.9	35.2	28.7	30.8	30.1	35.5	36.2	36.0
devel leadership abil in stdnts	42.5	46.9	48.5	32.7	45.0	45.5	48.2	44.5	54.1
economize and cut costs	38.0	36.8	33.8	34.5	33.4	33.1	36.2	30.5	36.0
enhance inst's national image	78.7	79.8	77.5	75.3	72.4	79.5	73.5	76.0	72.2
facilitate comm svcs involvement	21.0	21.7	22.0	21.7	27.8	27.0	34.1	34.4	36.7
help solve soc/environ problems	23.1	21.7	21.0	27.3	31.1	23.1	28.3	33.2	30.9
help students understand values	34.6	34.3	43.0	46.2	51.9	49.2	56.5	58.5	57.1
hire faculty "stars"	27.4	27.8	26.1	27.9	22.0	27.3	27.4	25.0	23.4
increase minorities in fac/admin	23.4	24.4	23.2	21.2	27.1	26.4	29.7	29.3	26.7
increase women in fac/admin	15.3	23.8	18.7	22.3	26.7	25.6	27.3	28.1	28.6
increase/maintain inst prestige	81.1	83.0	81.7	84.3	81.3	86.8	81.1	80.8	82.5
promote intellectual development	79.3	76.0	79.1	87.9	85.4	85.6	86.5	86.1	84.3
raise money for the institution	72.2	73.2	62.1	69.3	71.3	73.9	71.9	69.0	68.4
recruit more minority students	35.1	36.1	36.3	34.5	41.6	41.4	40.1	37.6	38.7
teach students how to change soc	18.6	20.6	24.6	22.3	28.3	26.4	30.7	36.3	33.9
Want Copy of Survey Results									
no	10.1	7.5	6.9	10.2	6.9	7.6	7.4	6.7	6.2
yes	89.9	92.5	93.1	89.8	93.1	92.4	92.6	93.3	93.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
None									
classes/labs	0.3	0.4	0.8	0.0	0.0	0.3	0.4	0.3	0.5
studying/homework	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.3	0.2
socializing with friends	0.3	0.4	0.0	0.0	0.4	0.3	0.0	0.0	0.2
talk with faculty outside class	7.5	7.9	8.7	2.5	3.1	6.0	7.9	4.2	5.8
exercising/sports	5.0	6.0	5.8	5.1	5.6	8.3	5.0	4.7	4.1
reading for pleasure	29.7	29.4	25.7	21.3	24.6	22.6	25.3	25.4	22.6
using a personal computer	6.8	13.3	13.5	27.4	19.4	21.3	26.1	27.5	24.8
partying	13.5	17.2	12.6	18.8	18.8	19.4	14.1	12.2	13.4
working (for pay)	41.5	32.9	33.4	17.3	24.5	21.9	27.7	24.6	23.5
volunteer work	70.7	69.0	67.0	72.6	65.0	61.4	50.8	45.3	58.0
student clubs/groups	28.2	35.1	33.4	36.2	35.3	32.1	21.3	30.5	32.2
watching TV	8.0	12.0	11.2	19.3	14.9	10.8	13.3	10.8	10.3
commuting to campus	42.8	44.8	48.7	54.4	50.6	54.5	49.7	47.0	46.6
religious services/meetings	49.6	55.8	50.8	61.7	58.2	57.7	46.2	49.6	49.4
hobbies	25.7	26.6	24.7	25.9	30.8	26.1	25.0	22.3	25.0
Six or More									
classes/labs	93.1	97.2	92.6	96.4	94.8	94.0	94.5	94.2	93.3
studying/homework	91.3	92.0	83.6	87.8	87.5	84.8	89.8	88.4	82.8
socializing with friends	76.2	71.0	80.0	78.7	78.2	74.3	79.3	78.7	78.2
talk with faculty outside class	2.0	3.6	3.9	5.1	6.2	3.6	4.1	6.6	4.8
exercising/sports	28.4	33.3	38.2	23.9	28.4	27.7	32.3	28.9	27.1
reading for pleasure	5.3	4.0	6.7	7.6	6.4	11.6	5.3	5.8	7.2
using a personal computer	28.2	31.7	27.1	17.8	20.2	27.2	14.3	16.9	19.0
partying	27.1	24.8	27.1	18.8	25.6	23.0	27.0	27.6	31.4
working (for pay)	43.1	52.0	56.1	60.7	57.3	59.9	56.2	61.6	65.0
volunteer work	1.1	2.0	3.0	1.5	3.5	4.5	7.6	8.6	6.9
student clubs/groups	10.6	8.4	12.0	10.2	11.5	10.5	13.1	13.9	13.8
watching TV	30.5	25.1	29.1	20.8	25.0	27.3	25.3	27.5	28.7
commuting to campus	7.7	9.6	7.5	3.1	6.2	6.3	6.9	8.3	7.7
religious services/meetings	2.0	2.4	2.4	1.0	1.2	1.5	1.3	1.4	2.7
hobbies	7.2	5.6	10.0	6.1	9.2	9.9	7.2	7.8	7.4
Sixteen or More									
classes/labs	60.9	64.5	54.8	62.4	56.6	51.2	60.8	51.0	49.0
studying/homework	55.0	55.4	40.8	44.4	45.9	36.0	42.3	38.8	33.8
socializing with friends	28.7	23.4	31.4	29.4	25.7	31.3	28.8	29.3	32.0
talk with faculty outside class	0.1	0.0	0.1	1.0	0.4	0.0	0.3	0.8	0.6
exercising/sports	4.8	7.1	6.5	2.0	6.4	4.8	4.7	6.9	5.5
reading for pleasure	0.1	0.4	0.5	1.0	0.6	2.7	0.7	0.8	0.2
using a personal computer	6.7	4.8	7.4	3.6	4.8	6.9	0.9	1.7	4.6
partying	3.6	2.4	5.8	3.6	4.5	4.2	4.7	3.6	7.1
working (for pay)	18.1	21.0	28.6	23.0	19.7	24.9	23.2	25.4	28.9
volunteer work	0.0	0.0	0.6	0.0	1.0	1.8	1.2	1.9	2.0
student clubs/groups	2.2	1.6	1.9	1.5	1.4	1.8	2.2	0.8	2.7
watching TV	5.4	4.4	5.2	3.0	2.5	5.1	3.4	3.3	5.0
commuting to campus	0.4	0.0	0.6	0.0	0.6	0.0	0.6	1.7	0.4
religious services/meetings	0.3	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.3
hobbies	1.5	2.0	1.6	0.0	1.2	3.0	1.5	1.7	1.3

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Religious Preference in 1985									
Baptist	9.4	12.3	7.8	3.6	8.7	5.3	8.2	11.5	9.4
Buddhist	0.6	0.5	0.6	0.0	0.2	0.3	0.6	0.6	0.2
Congregational (U.C.C.)	1.8	1.4	1.9	2.6	3.4	3.1	1.5	2.9	2.2
Eastern Orthodox	0.1	0.9	0.4	1.0	0.8	0.3	1.8	0.6	0.4
Episcopal	2.6	1.4	2.5	1.6	3.8	4.6	2.5	3.4	4.1
Islamic	0.0	0.5	0.4	0.0	0.0	0.0	0.3	0.0	0.4
Jewish	2.2	3.2	2.2	4.7	4.2	2.8	6.8	6.6	5.1
Latter Day Saints (Mormon)	0.3	0.9	0.5	0.0	0.0	0.0	0.1	0.0	0.2
Lutheran	9.7	6.4	6.1	5.2	5.0	5.9	4.9	4.0	5.3
Methodist	6.7	9.1	8.5	13.0	7.4	8.4	10.1	6.3	9.1
Presbyterian	6.2	4.1	4.7	6.7	4.0	8.7	6.7	7.2	6.1
Quaker (Society of Friends)	0.1	0.0	0.0	1.0	0.6	0.0	0.3	0.0	0.6
Roman Catholic	40.1	37.7	42.9	30.1	31.2	33.1	35.9	36.5	36.5
Seventh Day Adventist	0.3	0.0	0.1	1.0	0.2	0.6	0.6	0.3	0.3
other Protestant	4.0	5.9	5.7	8.8	5.8	5.0	5.3	5.2	5.7
other religion	3.5	4.1	3.8	3.6	3.0	7.1	5.3	4.6	3.9
none	12.2	11.8	11.9	17.1	21.5	14.9	9.1	10.3	10.4
in 1989									
Baptist	8.6	13.0	7.6	3.5	6.2	6.9	7.2	9.9	8.5
Buddhist	0.7	0.0	0.9	0.5	1.0	1.5	0.6	1.1	0.5
Congregational (UCC)	1.6	0.4	2.0	2.0	2.3	2.1	1.2	2.7	2.0
Eastern Orthodox	0.3	0.8	0.5	1.0	0.8	0.3	2.0	0.5	0.8
Episcopal	2.7	1.6	2.3	1.5	3.9	4.2	2.3	3.6	4.2
Islamic	0.0	0.8	0.3	0.0	0.0	0.0	0.4	0.0	0.3
Jewish	2.0	2.8	2.3	4.5	4.3	2.7	6.6	6.6	5.2
Latter Day Saints (Mormon)	0.1	0.4	0.5	0.0	0.0	0.0	0.1	0.0	0.2
Lutheran	8.5	4.7	6.0	1.0	4.6	5.4	4.5	3.6	4.3
Methodist	6.2	8.7	6.3	10.1	6.8	6.6	7.5	5.8	8.0
Presbyterian	6.4	3.9	3.9	7.0	4.1	5.1	5.8	6.9	5.6
Quaker	0.0	0.4	0.1	2.0	0.6	0.0	0.4	0.0	0.9
Roman Catholic	37.8	32.7	39.0	24.6	27.3	29.9	33.8	34.1	33.4
Seventh Day Adventist	0.1	0.0	0.0	0.0	0.2	0.3	0.4	0.0	0.2
other Protestant	4.5	7.1	7.1	5.5	5.8	6.0	7.9	4.7	5.7
other religion	2.7	4.3	3.1	7.5	4.1	4.8	4.8	3.0	3.9
none	17.7	18.5	18.1	29.1	28.2	24.3	14.3	17.6	16.3
Born-again Christian in 1985									
no	83.3	80.7	81.6	83.7	82.3	82.4	82.6	79.5	80.0
yes	16.7	19.3	18.4	16.3	17.7	17.6	17.4	20.5	20.0
in 1989									
no	83.2	78.8	81.7	84.3	86.1	87.9	81.8	83.3	82.8
yes	16.8	21.2	18.3	15.7	13.9	12.1	18.2	16.7	17.2

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Career in 1985 (7)									
artist (including performer)	0.0	3.4	0.0	0.0	3.0	0.0	0.0	4.5	0.0
business	0.0	14.6	0.0	0.0	5.2	0.0	0.0	8.7	0.0
clergy or religious worker	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
college teacher	0.0	0.5	0.0	2.5	0.6	4.4	0.0	0.9	0.0
doctor (MD or DDS)	0.0	9.2	0.0	0.0	21.4	0.0	79.1	0.0	62.2
education (secondary)	0.0	1.0	0.0	0.0	2.4	0.0	0.0	3.3	0.0
education (primary)	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.5	0.0
engineer	100.0	0.0	100.0	0.0	16.2	0.0	0.0	6.9	0.0
farmer or forester	0.0	1.9	0.0	9.5	0.6	9.8	0.0	0.6	0.0
health professional (non-M.D.)	0.0	2.4	0.0	0.0	7.2	0.0	11.4	6.9	16.9
lawyer	0.0	1.5	0.0	0.0	2.2	0.0	0.0	6.6	0.0
nurse	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	0.0
research scientist	0.0	12.6	0.0	85.4	0.0	80.5	0.0	8.7	0.0
other choice	0.0	31.1	0.0	2.5	18.2	5.3	9.4	16.1	20.9
undecided	0.0	21.8	0.0	0.0	21.6	0.0	0.0	31.9	0.0
Probable Career in 1989 (7)									
artist (including performer)	0.0	0.0	2.8	0.0	0.0	6.3	0.0	0.0	3.7
business	0.0	0.0	30.8	0.0	0.0	14.4	0.0	0.0	21.1
clergy or religious worker	0.0	0.0	0.1	0.0	0.0	0.6	0.0	0.0	1.5
college teacher	0.0	0.0	4.5	11.1	13.5	4.8	0.0	0.0	5.0
doctor (MD or DDS)	0.0	0.0	2.0	0.0	0.0	6.6	72.8	43.1	0.0
education (secondary)	0.0	0.0	4.6	0.0	0.0	10.8	0.0	0.0	7.0
education (primary)	0.0	0.0	1.3	0.0	0.0	2.4	0.0	0.0	5.5
engineer	100.0	100.0	0.0	0.0	0.0	8.4	0.0	0.0	2.1
farmer or forester	0.0	0.0	0.6	8.0	12.7	0.3	0.0	0.0	0.8
health professional (non-M.D.)	0.0	0.0	1.7	0.0	0.0	6.6	12.8	13.9	4.9
lawyer	0.0	0.0	4.0	0.0	0.0	3.6	0.0	0.0	8.9
nurse	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	2.0
research scientist	0.0	0.0	7.4	79.4	68.0	0.0	0.0	0.0	9.9
other choice	0.0	0.0	35.7	1.5	5.8	27.0	14.5	43.1	21.1
undecided	0.0	0.0	4.5	0.0	0.0	7.2	0.0	0.0	6.5
Reasons Noted as Very Important or Essential for Choosing Career									
job opportunities available	73.6	73.7	56.3	39.2	43.7	57.9	52.2	52.7	54.0
enjoy working w/people in field	51.5	50.2	66.5	57.4	64.5	71.5	81.8	85.2	75.3
work is interesting	94.7	93.7	94.0	99.5	98.7	93.5	97.8	98.1	95.9
pays well	68.9	65.9	49.2	26.6	30.6	40.5	51.4	47.1	46.9
satisfies parent's hopes	15.4	16.1	8.6	4.5	5.4	10.7	15.0	12.1	9.5
work is challenging	86.2	83.5	83.6	83.3	87.6	80.2	91.1	89.3	88.3
can make contribution to society	48.3	54.1	53.2	65.2	74.0	63.7	91.4	87.4	70.8
oppty for rapid career advancmnt	51.4	47.1	47.3	18.6	25.6	35.0	27.1	28.4	41.6
oppty for freedom of action	47.6	51.2	56.3	72.2	66.5	62.3	62.4	61.7	61.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Major in 1985 (7)									
agriculture	0.0	0.5	0.0	4.2	1.2	2.8	0.0	0.6	0.4
biological sciences	0.0	3.7	0.4	36.8	18.9	37.9	29.6	16.4	22.3
business	0.0	3.7	0.5	0.5	4.2	0.0	0.0	7.6	0.4
education	0.1	0.0	0.0	0.0	1.2	0.3	0.0	2.6	0.3
engineering	96.8	37.6	90.7	1.1	16.5	5.3	1.7	6.5	1.3
English	0.0	0.0	0.0	0.0	1.0	0.0	0.8	3.8	0.7
health professional	0.1	4.1	0.1	1.1	13.5	2.2	47.2	12.9	40.4
history or political science	0.1	1.4	0.0	0.5	2.4	0.6	0.2	1.8	0.4
humanities	0.0	0.9	0.1	0.0	1.8	0.6	0.6	2.3	0.5
fine arts	0.0	5.0	0.0	0.0	1.0	0.3	0.0	2.1	0.1
mathematics or statistics	0.1	6.9	1.3	5.3	5.2	9.3	0.3	1.2	0.4
physical sciences	0.7	10.6	3.9	48.4	12.3	32.3	4.1	3.2	5.2
social sciences	0.0	1.8	0.1	1.1	3.2	2.5	10.5	15.5	21.4
other technical	1.6	13.3	1.7	0.5	6.4	3.1	3.2	4.1	2.5
other non-technical	0.0	3.7	0.7	0.5	1.4	0.9	0.9	5.3	1.7
undecided	0.3	6.9	0.4	0.0	9.9	1.9	1.1	14.1	2.1
Major Reported in 1989 (7)									
agriculture	0.0	0.0	0.8	1.6	1.6	1.3	0.2	0.9	0.9
biological sciences	0.1	0.0	3.6	36.8	34.6	16.4	47.2	31.2	17.3
business	0.1	0.4	19.9	0.0	1.4	5.0	0.3	0.3	10.6
education	0.0	0.0	3.1	0.0	0.4	5.4	0.2	0.3	6.8
engineering	96.9	84.1	22.8	1.0	5.7	8.2	2.2	1.8	2.3
English	0.1	0.0	2.8	0.0	0.4	4.4	2.1	1.8	6.0
health professional	0.0	0.0	0.9	0.0	0.2	2.5	13.4	9.6	3.1
history or political science	0.0	0.0	4.7	0.0	0.4	7.6	1.3	1.8	7.6
humanities	0.0	0.0	2.5	0.5	0.6	3.8	2.2	1.8	4.1
fine arts	0.0	0.0	2.1	0.0	0.4	2.2	0.6	0.6	3.0
mathematics or statistics	0.7	2.2	4.1	5.2	10.5	7.3	0.2	0.0	1.8
physical sciences	1.3	8.6	9.7	51.3	31.6	12.6	9.1	3.6	6.0
social sciences	0.0	0.4	10.8	1.6	8.0	15.1	20.3	45.3	24.9
other technical	0.6	3.9	8.1	1.0	2.7	4.1	0.2	0.6	1.6
other non-technical	0.1	0.4	4.0	1.0	1.4	4.1	0.5	0.3	3.9
undecided	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Probable Graduate Major (7)									
agriculture	0.0	0.0	0.0	1.1	0.7	0.4	0.2	0.3	0.3
biological sciences	0.4	0.0	3.2	36.1	33.1	5.2	5.2	2.0	8.8
business	23.9	18.3	36.8	1.6	2.8	11.7	0.2	0.3	18.3
education	0.6	0.0	5.0	1.1	0.9	10.9	0.0	0.7	10.9
engineering	65.8	66.5	10.7	2.2	6.2	9.7	0.2	0.0	1.6
English	0.2	0.0	1.6	0.0	0.2	0.8	0.0	0.0	2.1
health professional	0.6	1.2	2.1	2.2	1.4	7.3	42.0	24.7	6.2
history or political science	0.2	0.0	3.2	0.0	0.5	4.8	0.0	0.0	1.8
humanities	0.2	0.0	2.3	0.0	0.5	4.4	0.0	0.0	3.2
fine arts	0.0	0.0	1.6	0.0	0.0	3.6	0.0	0.0	2.1
mathematics or statistics	0.0	1.8	1.2	3.3	7.9	3.2	0.0	0.0	1.0
physical sciences	1.5	1.8	6.8	44.3	28.2	5.2	0.4	0.3	4.7
social sciences	0.0	0.0	4.6	3.3	6.7	10.1	16.4	46.7	15.1
other technical	1.9	6.1	7.5	2.7	5.8	6.5	22.7	16.8	3.3
other non-technical	2.1	1.8	9.8	1.1	3.2	12.9	12.8	8.2	16.5
undecided	2.7	2.4	3.4	1.1	1.9	3.2	0.0	0.0	3.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
DISAGGREGATED RESPONSES									
Probable Career in 1985									
accountant or actuary	0.0	1.0	0.0	0.0	1.8	0.0	0.0	1.5	0.0
actor or entertainer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
architect or urban planner	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
artist	0.0	0.5	0.0	0.0	0.6	0.0	0.0	0.3	0.0
business (clerical)	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
business executive (mgmt,admin)	0.0	9.2	0.0	0.0	2.6	0.0	0.0	5.4	0.0
business owner or proprietor	0.0	4.4	0.0	0.0	0.6	0.0	0.0	1.5	0.0
business salesperson or buyer	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0
clergy (minister,priest)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
clergy (other religious)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
clinical psychologist	0.0	0.5	0.0	0.0	1.6	0.0	9.4	0.0	20.9
college teacher	0.0	0.5	0.0	2.5	0.6	4.4	0.0	0.9	0.0
computer programmer or analyst	0.0	12.6	0.0	0.0	5.4	0.0	0.0	1.8	0.0
conservationist or forester	0.0	1.0	0.0	9.5	0.0	9.8	0.0	0.6	0.0
dentist (including orthodontist)	0.0	0.5	0.0	0.0	0.8	0.0	4.8	0.0	4.7
dietitian or home economist	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.3	0.0
engineer	100.0	0.0	100.0	0.0	16.2	0.0	0.0	6.9	0.0
farmer or rancher	0.0	1.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
frgn svc worker (incl diplomat)	0.0	0.0	0.0	0.0	1.6	0.0	0.0	1.2	0.0
homemaker (full-time)	0.0	0.5	0.0	0.0	0.2	0.0	0.0	0.0	0.0
interior decorator or designer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
interpreter (translator)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lab technician or hygienist	0.0	0.0	0.0	0.0	2.0	0.0	0.0	2.7	0.0
law enforcement officer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lawyer (attorney) or judge	0.0	1.5	0.0	0.0	2.2	0.0	0.0	6.6	0.0
military service (career)	0.0	4.4	0.0	0.0	0.6	0.0	0.0	0.6	0.0
musician (performer,composer)	0.0	2.9	0.0	0.0	1.0	0.0	0.0	0.6	0.0
nurse	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	0.0
optometrist	0.0	1.0	0.0	0.0	0.6	0.0	2.3	0.0	2.2
pharmacist	0.0	0.5	0.0	0.0	0.8	0.0	3.9	0.0	5.1
physician	0.0	8.7	0.0	0.0	20.6	0.0	74.3	0.0	57.5
school counselor	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.5	0.0
school principal/superintendent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
scientific researcher	0.0	12.6	0.0	85.4	0.0	80.5	0.0	8.7	0.0
social,welfare or rec worker	0.0	0.0	0.0	0.0	0.2	0.0	0.0	3.0	0.0
statistician	0.0	0.0	0.0	2.5	0.0	5.3	0.0	0.3	0.0
therapist (phys,occup,speech)	0.0	0.0	0.0	0.0	0.8	0.0	0.0	3.9	0.0
teacher/admin (elementary)	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.5	0.0
teacher/admin (secondary)	0.0	1.0	0.0	0.0	2.0	0.0	0.0	1.8	0.0
veterinarian	0.0	0.5	0.0	0.0	3.0	0.0	5.2	0.0	9.5
writer or journalist	0.0	0.0	0.0	0.0	1.4	0.0	0.0	2.7	0.0
skilled trades	0.0	1.5	0.0	0.0	0.2	0.0	0.0	0.6	0.0
other	0.0	6.8	0.0	0.0	7.8	0.0	0.0	8.7	0.0
undecided	0.0	21.8	0.0	0.0	21.6	0.0	0.0	31.9	0.0

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Career in 1989									
accountant or actuary	0.0	0.0	5.5	0.0	0.0	3.9	0.0	0.0	2.6
actor or entertainer	0.0	0.0	0.3	0.0	0.0	0.9	0.0	0.0	0.3
architect or urban planner	0.0	0.0	0.9	0.0	0.0	0.3	0.0	0.0	0.7
artist	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.8
business (clerical)	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.2
business executive (mgmt,admin)	0.0	0.0	18.3	0.0	0.0	9.3	0.0	0.0	13.8
business owner or proprietor	0.0	0.0	4.0	0.0	0.0	0.9	0.0	0.0	2.8
business salesperson or buyer	0.0	0.0	3.1	0.0	0.0	0.3	0.0	0.0	1.8
clergy (minister,priest)	0.0	0.0	0.1	0.0	0.0	0.6	0.0	0.0	0.8
clergy (other religious)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
clinical psychologist	0.0	0.0	0.5	0.0	0.0	1.5	14.5	43.1	0.0
college teacher	0.0	0.0	4.5	11.1	13.5	4.8	0.0	0.0	5.0
computer programmer or analyst	0.0	0.0	10.0	0.0	0.0	4.8	0.0	0.0	2.0
conservationist or forester	0.0	0.0	0.6	8.0	12.7	0.0	0.0	0.0	0.8
dentist (including orthodontist)	0.0	0.0	0.3	0.0	0.0	0.3	7.2	3.5	0.0
dietitian or home economist	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
engineer	100.0	100.0	0.0	0.0	0.0	8.4	0.0	0.0	2.1
farmer or rancher	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
frgn svc worker (incl diplomat)	0.0	0.0	0.5	0.0	0.0	0.6	0.0	0.0	0.9
homemaker (full-time)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
interior decorator or designer	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3
interpreter (translator)	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.0
lab technician or hygienist	0.0	0.0	0.4	0.0	0.0	3.0	0.0	0.0	2.0
law enforcement officer	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.8
lawyer (attorney) or judge	0.0	0.0	4.0	0.0	0.0	3.6	0.0	0.0	8.9
military service (career)	0.0	0.0	13.0	0.0	0.0	3.0	0.0	0.0	1.0
musician (performer,composer)	0.0	0.0	0.4	0.0	0.0	0.6	0.0	0.0	0.3
nurse	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	2.0
optometrist	0.0	0.0	0.0	0.0	0.0	0.0	3.2	1.4	0.0
pharmacist	0.0	0.0	0.1	0.0	0.0	1.5	5.1	9.5	0.0
physician	0.0	0.0	1.8	0.0	0.0	6.3	65.5	39.5	0.0
school counselor	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.0	1.5
school principal/superintendent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
scientific researcher	0.0	0.0	7.4	79.4	68.0	0.0	0.0	0.0	9.9
social,welfare or rec worker	0.0	0.0	0.3	0.0	0.0	1.2	0.0	0.0	4.8
statistician	0.0	0.0	0.6	1.5	5.8	0.0	0.0	0.0	0.2
therapist (phys,occup,speech)	0.0	0.0	0.9	0.0	0.0	2.1	0.0	0.0	2.3
teacher/admin (elementary)	0.0	0.0	1.3	0.0	0.0	2.4	0.0	0.0	5.5
teacher/admin (secondary)	0.0	0.0	4.3	0.0	0.0	10.2	0.0	0.0	5.6
veterinarian	0.0	0.0	0.3	0.0	0.0	0.0	4.5	3.0	0.0
writer or journalist	0.0	0.0	1.4	0.0	0.0	4.2	0.0	0.0	2.1
skilled trades	0.0	0.0	0.3	0.0	0.0	1.2	0.0	0.0	0.0
other	0.0	0.0	8.7	0.0	0.0	13.8	0.0	0.0	10.5
undecided	0.0	0.0	4.5	0.0	0.0	7.2	0.0	0.0	6.5

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Major Reported in 1985									
Arts and Humanities									
art, fine & applied	0.0	0.9	0.0	0.0	0.4	0.0	0.0	0.3	0.0
English (language & literature)	0.0	0.0	0.0	0.0	1.0	0.0	0.8	3.8	0.7
history	0.0	0.5	0.0	0.5	0.6	0.3	0.2	0.6	0.3
journalism	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.9	0.1
language (except English)	0.0	0.0	0.0	0.0	1.0	0.0	0.2	1.2	0.1
music	0.0	0.9	0.0	0.0	0.6	0.0	0.0	1.8	0.1
philosophy	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.0	0.1
speech	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
theater or drama	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.9	0.1
theology or religion	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
other arts and humanities	0.0	0.9	0.0	0.0	0.2	0.3	0.3	0.3	0.2
Biological Sciences									
biology (general)	0.0	1.4	0.4	8.4	9.5	14.9	20.6	9.7	14.9
biochemistry or biophysics	0.0	0.9	0.0	10.5	4.2	7.1	6.3	2.3	3.8
botany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
marine (life) science	0.0	0.5	0.0	4.7	1.0	5.0	0.0	0.9	0.2
microbiology or bacteriology	0.0	0.5	0.0	4.2	1.2	1.9	1.1	0.9	0.8
zoology	0.0	0.0	0.0	1.6	0.6	2.5	0.3	0.9	1.3
other biological sciences	0.0	0.5	0.0	7.4	2.4	6.5	1.4	1.8	1.3
Business									
accounting	0.0	0.5	0.0	0.0	1.2	0.0	0.0	1.2	0.1
business admin (general)	0.0	0.9	0.0	0.5	1.0	0.0	0.0	3.5	0.3
finance	0.0	0.5	0.0	0.0	0.4	0.0	0.0	0.6	0.0
marketing	0.0	0.9	0.3	0.0	0.6	0.0	0.0	0.9	0.0
management	0.0	0.9	0.3	0.0	0.8	0.0	0.0	0.6	0.0
secretarial studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other business	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.9	0.0
Education									
business education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
elementary education	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0
music or art education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
physical education or recreation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
secondary education	0.1	0.0	0.0	0.0	1.0	0.3	0.0	0.9	0.0
special education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.3
other education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Engineering									
aeronautical/astronautical eng	8.6	3.7	13.2	0.0	2.2	0.6	0.0	0.3	0.0
civil engineering	6.7	2.8	6.0	0.0	0.6	0.3	0.0	0.3	0.1
chemical engineering	8.2	2.3	8.8	0.0	2.8	1.6	0.2	0.6	0.3
electrical/electronic eng	38.6	14.7	31.8	1.1	4.6	0.9	0.3	2.3	0.2
industrial engineering	3.7	0.9	3.7	0.0	0.4	0.0	0.0	0.0	0.0
mechanical engineering	19.9	6.4	12.4	0.0	1.6	0.0	0.0	0.3	0.1
other engineering	11.0	6.9	14.7	0.0	4.4	1.9	1.2	2.6	0.7

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Major Reported in 1985									
Physical Sciences									
astronomy	0.0	0.5	0.1	2.6	0.2	1.6	0.0	0.0	0.0
atmospheric science	0.0	0.0	0.1	0.5	0.6	0.6	0.0	0.0	0.1
chemistry	0.1	2.3	1.1	16.3	6.4	13.0	3.6	1.2	4.5
earth science	0.0	0.9	0.0	1.6	0.8	1.2	0.0	0.0	0.0
marine science	0.0	0.0	0.3	1.1	0.2	2.2	0.0	0.9	0.2
mathematics	0.1	6.4	1.3	4.7	5.0	8.1	0.3	0.9	0.4
physics	0.6	6.4	2.3	25.8	3.6	12.4	0.5	0.6	0.4
statistics	0.0	0.5	0.0	0.5	0.2	1.2	0.0	0.3	0.0
other physical sciences	0.0	0.5	0.0	0.5	0.6	1.2	0.0	0.6	0.0
Professional									
architecture/urban planning	0.0	3.2	0.0	0.0	0.0	0.3	0.0	0.0	0.0
home economics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
health technology	0.0	0.0	0.0	0.5	1.6	1.9	3.2	2.6	2.4
library or archival science	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nursing	0.0	0.0	0.0	0.0	0.8	0.0	0.2	3.2	0.3
pharmacy	0.0	0.5	0.0	0.0	0.4	0.0	3.3	0.9	4.0
predent,premed,prevet	0.1	3.7	0.1	1.1	11.5	2.2	43.6	6.2	35.5
therapy (phys,occupat,etc)	0.0	0.0	0.0	0.0	0.8	0.0	0.2	2.6	0.6
other professional	0.0	0.0	0.0	0.0	0.2	0.0	0.9	1.8	1.4
Social Sciences									
anthropology	0.0	0.0	0.0	0.5	0.0	0.6	0.0	0.3	0.3
economics	0.0	0.5	0.0	0.0	0.6	0.0	0.0	0.3	0.0
ethnic studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
geography	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
political science	0.1	0.9	0.0	0.0	1.8	0.3	0.0	1.2	0.2
psychology	0.0	1.4	0.1	0.5	2.6	1.2	10.4	13.5	20.8
social work	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.3
sociology	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.0
women's studies	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
other social sciences	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Technical									
building trades	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
data processing,computer prog	0.1	6.0	0.0	0.0	2.0	0.3	0.0	0.6	0.1
drafting or design	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.6	0.0
electronics	0.4	0.9	0.7	0.0	0.2	0.0	0.0	0.0	0.0
mechanics	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other technical	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.0
Other Fields									
agriculture	0.0	0.0	0.0	1.1	1.2	0.3	0.0	0.3	0.4
communications	0.0	1.8	0.4	0.0	0.2	0.0	0.0	1.2	0.0
computer science	0.4	5.0	0.9	0.0	2.2	0.9	0.0	0.3	0.1
forestry	0.0	0.5	0.0	3.2	0.0	2.5	0.0	0.3	0.0
law enforcement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
military science	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
other field	0.0	0.9	0.1	0.5	0.8	0.9	0.0	0.3	0.2
undecided	0.3	6.9	0.4	0.0	9.9	1.9	1.1	14.1	2.1

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Major Reported in 1989									
Arts and Humanities									
art, fine & applied	0.0	0.0	1.1	0.0	0.2	1.3	0.3	0.0	1.7
English (language & literature)	0.1	0.0	2.8	0.0	0.4	4.4	2.1	1.8	6.0
history	0.0	0.0	1.9	0.0	0.0	2.5	0.8	0.3	3.0
journalism	0.0	0.0	0.1	0.0	0.2	1.3	0.0	0.0	0.6
language (except English)	0.0	0.0	0.7	0.0	0.0	0.6	1.0	0.9	1.8
music	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.5
philosophy	0.0	0.0	0.5	0.5	0.6	0.6	1.0	0.6	0.8
speech	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.3	0.7
theater or drama	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	0.3
theology or religion	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.4
other arts and humanities	0.0	0.0	0.9	0.0	0.0	1.6	0.3	0.3	0.8
Biological Sciences									
biology (general)	0.0	0.0	1.6	19.2	23.0	11.7	36.5	22.5	13.5
biochemistry or biophysics	0.1	0.0	0.8	4.1	3.3	1.6	4.5	2.7	1.5
botany	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
marine (life) science	0.0	0.0	0.0	2.6	0.2	0.3	0.0	0.0	0.0
microbiology or bacteriology	0.0	0.0	0.5	2.6	2.0	0.6	0.6	1.2	0.6
zoology	0.0	0.0	0.3	1.0	0.6	0.6	0.5	0.6	0.2
other biological sciences	0.0	0.0	0.4	7.3	5.5	1.6	5.0	4.2	1.6
Business									
accounting	0.0	0.0	4.1	0.0	0.2	0.9	0.0	0.0	2.1
business admin (general)	0.0	0.0	2.3	0.0	0.0	1.6	0.2	0.3	1.5
finance	0.0	0.4	4.3	0.0	0.0	0.6	0.0	0.0	1.3
marketing	0.0	0.0	2.7	0.0	0.6	0.9	0.0	0.0	1.6
management	0.1	0.0	4.8	0.0	0.6	0.9	0.2	0.0	3.2
secretarial studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other business	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	1.0
Education									
business education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
elementary education	0.0	0.0	0.9	0.0	0.2	0.9	0.0	0.0	3.7
music or art education	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1
physical education or recreation	0.0	0.0	0.4	0.0	0.0	0.6	0.0	0.3	0.9
secondary education	0.0	0.0	1.2	0.0	0.0	2.2	0.0	0.0	1.2
special education	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.6
other education	0.0	0.0	0.3	0.0	0.2	0.6	0.2	0.0	0.3
Engineering									
aeronautical/astronautical eng	4.6	3.9	2.4	0.0	0.2	0.0	0.0	0.0	0.1
civil engineering	9.2	10.3	1.3	0.0	0.0	0.6	0.0	0.0	0.1
chemical engineering	6.6	5.6	1.7	0.0	1.0	1.3	0.2	0.3	0.5
electrical/electronic eng	33.5	22.4	7.3	0.0	1.2	2.8	0.6	0.9	0.5
industrial engineering	6.6	10.8	1.1	0.0	0.2	0.6	0.0	0.0	0.1
mechanical engineering	26.3	20.7	4.9	0.5	1.6	1.3	0.2	0.0	0.6
other engineering	10.0	10.3	4.0	0.5	1.4	1.6	1.3	0.6	0.6

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Major Reported in 1989									
Physical Sciences									
astronomy	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
atmospheric science	0.0	0.0	0.1	0.5	0.6	0.3	0.0	0.0	0.0
chemistry	0.0	1.3	3.3	16.6	18.2	5.0	8.6	3.3	5.1
earth science	0.0	0.0	0.9	5.7	3.7	0.9	0.0	0.0	0.2
marine science	0.0	0.0	0.4	0.5	0.2	0.0	0.0	0.0	0.0
mathematics	0.7	2.2	3.9	4.1	9.6	7.3	0.2	0.0	1.8
physics	1.3	7.3	4.1	26.4	7.8	6.0	0.2	0.3	0.6
statistics	0.0	0.0	0.3	1.0	0.8	0.0	0.0	0.0	0.0
other physical sciences	0.0	0.0	0.8	0.5	1.0	0.3	0.3	0.0	0.1
Professional									
architecture/urban planning	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.2
home economics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
health technology	0.0	0.0	0.4	0.5	0.2	0.9	0.2	0.6	0.5
law	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
library or archival science	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nursing	0.0	0.0	0.1	0.0	0.0	0.3	0.2	0.6	1.6
pharmacy	0.0	0.0	0.1	0.0	0.2	0.9	4.0	5.1	0.1
predent,premed,prevet	0.0	0.0	0.0	0.0	0.0	0.3	9.3	3.6	0.7
therapy (phys,occupat,etc)	0.0	0.0	0.7	0.0	0.0	0.9	0.0	0.3	0.7
other professional	0.0	0.0	0.4	0.0	0.0	0.0	0.2	0.0	0.8
Social Sciences									
anthropology	0.0	0.0	0.3	0.5	0.2	1.9	0.5	1.5	0.7
economics	0.0	0.4	5.7	0.0	0.6	4.4	0.8	0.3	3.8
ethnic studies	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2
geography	0.0	0.0	0.3	0.0	0.4	1.3	0.0	0.0	0.1
political science	0.0	0.0	2.8	0.0	0.4	5.0	0.5	1.5	4.7
psychology	0.0	0.0	3.5	1.0	5.5	4.4	17.9	40.8	15.6
social work	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3	1.4
sociology	0.0	0.0	0.0	0.0	0.6	1.6	0.5	1.8	2.1
women's studies	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.2
other social sciences	0.0	0.0	0.8	0.0	0.6	1.3	0.6	0.3	0.9
Technical									
building trades	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
data processing,computer prog	0.0	0.0	1.9	0.0	0.0	0.9	0.0	0.0	0.7
drafting or design	0.4	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0
electronics	0.1	1.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
mechanics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other technical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Fields									
agriculture	0.0	0.0	0.7	0.5	1.0	0.9	0.2	0.9	0.8
communications	0.0	0.4	2.0	0.5	0.0	1.3	0.0	0.0	1.5
computer science	0.0	1.7	5.6	0.5	2.5	2.2	0.0	0.0	0.5
forestry	0.0	0.0	0.1	1.0	0.6	0.3	0.0	0.0	0.1
law enforcement	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.1
military science	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other field	0.0	0.0	1.2	0.5	1.2	0.9	0.3	0.3	0.7
undecided	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Graduate Major									
Arts and Humanities									
art, fine & applied	0.0	0.0	0.2	0.0	0.0	2.0	0.0	0.0	1.3
English (language & literature)	0.2	0.0	1.6	0.0	0.2	0.8	0.0	0.0	2.1
history	0.0	0.0	1.1	0.0	0.0	1.6	0.0	0.0	0.5
journalism	0.0	0.0	0.4	0.0	0.0	0.8	0.0	0.0	0.3
language (except English)	0.2	0.0	0.2	0.0	0.0	1.6	0.0	0.0	0.7
music	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.3
philosophy	0.0	0.0	0.7	0.0	0.0	0.8	0.0	0.0	0.2
speech	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.1
theater or drama	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
theology or religion	0.0	0.0	0.7	0.0	0.0	1.2	0.0	0.0	1.4
other arts and humanities	0.0	0.0	0.5	0.0	0.5	0.8	0.0	0.0	0.7
Biological Sciences									
biology (general)	0.0	0.0	0.2	3.8	2.3	0.8	2.0	0.3	1.0
biochemistry or biophysics	0.4	0.0	0.9	10.9	7.2	1.2	0.6	0.3	1.6
botany	0.0	0.0	0.0	0.5	1.4	0.0	0.0	0.0	0.1
marine (life) science	0.0	0.0	0.0	3.8	2.1	1.6	0.0	0.0	0.0
microbiology or bacteriology	0.0	0.0	0.4	3.8	4.4	0.0	0.6	0.3	1.6
zoology	0.0	0.0	0.4	1.1	1.2	0.0	0.2	0.0	0.3
other biological sciences	0.0	0.0	1.4	12.0	14.6	1.6	1.9	1.0	4.1
Business									
accounting	0.0	0.0	1.4	0.0	0.0	2.0	0.0	0.0	0.8
business admin (general)	14.7	12.8	16.1	1.6	1.6	5.2	0.0	0.3	7.6
finance	1.5	1.8	4.6	0.0	0.0	2.4	0.0	0.0	3.0
marketing	0.6	0.0	4.3	0.0	0.2	0.0	0.0	0.0	1.9
management	6.6	3.0	8.0	0.0	0.7	1.6	0.2	0.0	3.7
secretarial studies	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
other business	0.4	0.6	2.3	0.0	0.2	0.0	0.0	0.0	1.4
Education									
business education	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
elementary education	0.0	0.0	0.7	0.0	0.0	2.0	0.0	0.0	3.4
music or art education	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2
physical education or recreation	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.6
secondary education	0.4	0.0	2.1	0.5	0.2	4.0	0.0	0.0	2.8
special education	0.0	0.0	0.5	0.0	0.2	1.6	0.0	0.3	1.3
other education	0.0	0.0	1.4	0.5	0.5	1.6	0.0	0.3	2.4
Engineering									
aeronautical/astronautical eng	5.0	6.1	3.0	0.0	0.7	0.8	0.0	0.0	0.1
civil engineering	6.8	9.1	0.7	0.0	0.2	0.4	0.2	0.0	0.1
chemical engineering	3.3	2.4	0.4	0.5	0.9	0.8	0.0	0.0	0.3
electrical/electronic eng	23.0	22.6	2.3	0.5	0.5	3.6	0.0	0.0	0.2
industrial engineering	3.7	5.5	0.4	0.0	0.5	0.0	0.0	0.0	0.0
mechanical engineering	13.9	11.0	1.2	0.5	0.7	1.2	0.0	0.0	0.0
other engineering	10.0	9.8	2.7	0.5	2.8	2.8	0.0	0.0	0.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Graduate Major									
Physical Sciences									
astronomy	0.4	0.6	0.4	3.8	0.9	0.4	0.0	0.0	0.0
atmospheric science	0.0	0.0	0.2	0.5	0.5	0.0	0.0	0.0	0.0
chemistry	0.0	0.0	1.8	10.4	16.0	0.8	0.4	0.3	4.4
earth science	0.0	0.0	0.9	7.7	3.2	1.2	0.0	0.0	0.2
marine science	0.0	0.6	0.5	0.5	1.4	0.4	0.0	0.0	0.0
mathematics	0.0	1.8	0.9	2.7	4.2	2.8	0.0	0.0	0.9
physics	0.6	0.0	2.7	19.7	5.1	2.0	0.0	0.0	0.1
statistics	0.0	0.0	0.4	0.5	3.7	0.4	0.0	0.0	0.1
other physical sciences	0.4	0.6	0.4	1.6	1.2	0.4	0.0	0.0	0.0
Professional									
architecture/urban planning	0.0	0.0	1.4	0.0	0.0	0.8	0.0	0.0	0.3
home economics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
health technology	0.2	0.0	0.9	1.6	2.5	4.0	22.7	16.8	1.5
law	1.7	0.6	6.8	0.0	0.2	6.5	0.0	0.7	11.7
library or archival science	0.0	0.0	0.0	0.0	0.5	0.8	0.0	0.0	0.2
nursing	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.3	1.6
pharmacy	0.0	0.0	0.0	1.6	0.2	1.2	2.6	5.6	0.2
predent,premed,prevet	0.6	1.2	1.2	0.5	0.9	3.6	39.2	18.4	1.5
therapy (phys,occupat,etc)	0.0	0.0	0.9	0.0	0.2	2.0	0.2	0.3	2.9
other professional	0.2	0.0	0.7	0.5	0.2	0.8	12.5	6.6	1.6
Social Sciences									
anthropology	0.0	0.0	0.4	1.1	0.0	0.8	0.0	0.7	0.3
economics	0.0	0.0	0.5	0.0	0.5	2.4	0.0	0.0	0.8
ethnic studies	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
geography	0.0	0.0	0.2	0.0	0.7	0.4	0.0	0.0	0.0
political science	0.2	0.0	2.1	0.0	0.5	3.2	0.0	0.0	1.4
psychology	0.0	0.0	2.7	2.2	4.4	3.2	16.2	42.8	8.0
social work	0.0	0.0	0.2	0.0	0.0	1.2	0.0	1.6	3.9
sociology	0.0	0.0	0.2	0.0	0.7	0.8	0.0	0.7	0.8
women's studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
other social sciences	0.0	0.0	0.4	0.0	0.5	1.2	0.2	1.0	0.9
Technical									
building trades	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1
data processing,computer prog	0.2	1.2	2.0	0.0	0.2	0.8	0.0	0.0	0.7
drafting or design	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
electronics	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1
mechanics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other technical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Fields									
agriculture	0.0	0.0	0.0	1.1	0.5	0.0	0.2	0.3	0.0
communications	0.0	0.6	0.5	0.0	0.0	0.0	0.0	0.0	1.0
computer science	1.5	4.3	4.6	1.1	3.0	1.6	0.0	0.0	0.7
forestry	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.3
law enforcement	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2
military science	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0	0.1
other field	0.2	0.0	1.1	0.5	2.3	3.2	0.4	1.0	0.9
undecided	2.7	2.4	3.4	1.1	1.9	3.2	0.0	0.0	3.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
Classes/Labs									
none	0.3	0.4	0.8	0.0	0.0	0.3	0.4	0.3	0.5
less than one	0.1	0.0	0.6	0.0	0.2	0.3	0.0	0.0	0.2
1 - 2	0.7	0.4	1.6	0.5	0.8	0.9	0.9	1.9	1.5
3 - 5	5.8	2.0	4.4	3.0	4.2	4.5	4.2	3.6	4.6
6 - 10	9.9	9.6	9.4	11.2	9.3	14.0	9.9	12.4	12.3
11 - 15	22.3	23.1	28.3	22.8	29.0	28.9	23.8	30.9	32.0
16 - 20	36.7	45.8	33.4	29.4	30.5	31.0	31.6	30.9	31.0
over 20	24.2	18.7	21.4	33.0	26.1	20.2	29.2	20.1	18.0
Studying/Homework									
none	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.3	0.2
less than one	0.4	0.0	0.6	0.0	0.2	0.6	0.1	0.3	0.3
1 - 2	1.2	2.0	2.5	2.6	1.5	1.8	1.3	1.9	2.4
3 - 5	7.1	6.0	13.1	9.2	10.8	12.8	8.8	9.1	14.2
6 - 10	16.3	18.7	23.9	22.4	20.5	26.2	25.3	28.9	27.8
11 - 15	20.0	17.9	19.0	20.9	21.0	22.6	22.2	20.7	21.2
16 - 20	21.1	19.9	16.9	15.8	18.0	14.9	17.2	19.3	16.4
over 20	33.9	35.5	23.9	28.6	28.0	21.1	25.1	19.6	17.4
Socializing with Friends									
none	0.3	0.4	0.0	0.0	0.4	0.3	0.0	0.0	0.2
less than one	0.7	1.2	0.8	1.0	0.4	0.9	0.6	0.8	0.9
1 - 2	4.8	5.6	4.8	3.0	4.9	4.5	3.5	3.3	4.2
3 - 5	18.0	21.8	14.4	17.3	16.1	20.0	16.6	17.1	16.5
6 - 10	30.7	28.6	28.6	32.5	30.4	25.7	29.4	26.8	29.3
11 - 15	16.8	19.0	20.0	16.8	22.2	17.3	21.1	22.7	16.8
16 - 20	13.9	9.5	12.7	13.7	10.5	12.8	11.9	12.7	11.7
over 20	14.8	13.9	18.7	15.7	15.2	18.5	16.9	16.6	20.4
Talk with Faculty Outside Class									
none	7.5	7.9	8.7	2.5	3.1	6.0	7.9	4.2	5.8
less than one	44.9	38.9	39.6	28.4	29.3	35.1	31.1	34.1	33.0
1 - 2	34.7	37.7	35.8	42.1	40.7	38.4	39.2	41.8	39.3
3 - 5	10.8	11.9	11.9	21.8	20.7	17.0	17.7	13.3	17.0
6 - 10	1.6	2.0	3.5	3.6	4.8	3.0	2.9	4.7	3.5
11 - 15	0.3	1.6	0.3	0.5	1.0	0.6	0.9	1.1	0.7
16 - 20	0.1	0.0	0.1	0.5	0.2	0.0	0.3	0.3	0.3
over 20	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.6	0.3
Exercising/Sports									
none	5.0	6.0	5.8	5.1	5.6	8.3	5.0	4.7	4.1
less than one	11.8	9.1	9.9	17.3	12.4	14.0	11.7	10.5	14.1
1 - 2	22.1	21.8	19.1	24.4	25.7	25.9	19.3	24.2	22.0
3 - 5	32.6	29.8	26.9	29.4	27.9	24.1	31.7	31.7	32.7
6 - 10	16.4	20.2	24.5	14.2	16.1	17.9	20.9	18.7	15.7
11 - 15	7.2	6.0	7.2	7.6	6.0	5.1	6.7	3.3	5.9
16 - 20	1.8	4.8	3.6	1.0	3.3	2.1	2.5	3.3	2.0
over 20	3.0	2.4	2.9	1.0	3.1	2.7	2.2	3.6	3.5

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
Reading for Pleasure									
none	29.7	29.4	25.7	21.3	24.6	22.6	25.3	25.4	22.6
less than one	30.6	27.4	26.1	31.5	28.6	27.7	29.7	27.1	30.2
1 - 2	24.6	27.0	27.2	26.9	26.5	23.5	25.7	26.5	26.3
3 - 5	9.8	12.3	14.2	12.7	13.9	14.6	14.0	15.2	13.7
6 - 10	4.4	2.8	5.3	6.1	4.6	7.4	3.9	3.9	6.2
11 - 15	0.8	0.8	0.9	0.5	1.2	1.5	0.6	1.1	0.8
16 - 20	0.1	0.4	0.0	0.5	0.0	1.5	0.4	0.3	0.1
over 20	0.0	0.0	0.5	0.5	0.6	1.2	0.3	0.6	0.1
Using a Personal Computer									
none	6.8	13.3	13.5	27.4	19.4	21.3	26.1	27.5	24.8
less than one	13.1	11.6	13.3	16.8	17.2	10.5	16.3	14.4	14.6
1 - 2	23.8	18.9	21.6	20.8	22.5	21.3	20.2	23.6	21.0
3 - 5	28.1	24.5	24.5	17.3	20.7	19.8	23.1	17.5	20.6
6 - 10	15.7	16.1	13.8	9.6	10.9	14.4	9.4	12.8	9.7
11 - 15	5.9	10.8	5.9	4.6	4.5	6.0	4.0	2.5	4.8
16 - 20	3.1	2.8	3.3	0.5	2.3	3.3	0.6	1.1	2.3
over 20	3.5	2.0	4.2	3.0	2.5	3.6	0.3	0.6	2.2
Partying									
none	13.5	17.2	12.6	18.8	18.8	19.4	14.1	12.2	13.4
less than one	11.9	18.4	13.6	16.8	15.7	15.2	12.6	11.6	12.6
1 - 2	18.3	15.2	19.6	21.3	18.0	17.3	18.2	19.9	18.6
3 - 5	29.1	24.4	27.1	24.4	21.9	25.1	28.2	28.7	24.0
6 - 10	17.8	16.8	13.9	11.2	15.3	14.9	14.7	18.8	17.8
11 - 15	5.7	5.6	7.4	4.1	5.8	3.9	7.6	5.2	6.5
16 - 20	1.5	1.2	2.5	1.5	1.9	3.0	2.5	1.7	3.8
over 20	2.1	1.2	3.3	2.0	2.5	1.2	2.2	1.9	3.3
Working (for Pay)									
none	41.5	32.9	33.4	17.3	24.5	21.9	27.7	24.6	23.5
less than one	1.9	2.8	2.0	1.5	1.4	2.1	2.1	0.3	0.8
1 - 2	4.4	4.0	2.4	6.1	3.7	4.5	3.2	3.6	2.2
3 - 5	9.1	8.3	6.1	14.3	13.1	11.7	10.9	9.9	8.5
6 - 10	15.7	19.0	16.6	23.5	24.1	19.2	20.1	17.1	18.6
11 - 15	9.3	11.9	10.8	14.3	13.5	15.9	12.9	19.1	17.5
16 - 20	9.1	11.5	12.1	13.3	11.4	12.3	13.0	14.4	13.7
over 20	9.0	9.5	16.5	9.7	8.3	12.6	10.1	11.0	15.2
Volunteer Work									
none	70.7	69.0	67.0	72.6	65.0	61.4	50.8	45.3	58.0
less than one	14.2	15.1	13.6	11.2	13.3	14.8	11.1	12.8	13.4
1 - 2	10.2	10.3	10.8	10.7	11.4	12.0	15.2	19.4	12.2
3 - 5	3.8	3.6	5.5	4.1	6.8	7.2	15.2	13.9	9.5
6 - 10	1.0	2.0	2.1	1.5	2.5	2.1	5.0	5.8	3.6
11 - 15	0.1	0.0	0.3	0.0	0.0	0.6	1.5	0.8	1.2
16 - 20	0.0	0.0	0.3	0.0	0.6	0.3	0.6	1.4	1.1
over 20	0.0	0.0	0.4	0.0	0.4	1.5	0.6	0.6	0.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: CAREERS

ITEM	ENGINEER			SCIENTIST			PRACTITIONER		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
Student Clubs/Groups									
none	28.2	35.1	33.4	36.2	35.3	32.1	21.3	30.5	32.2
less than one	15.3	13.5	13.4	11.7	15.8	12.9	12.2	10.8	12.0
1 - 2	27.7	25.1	22.9	20.4	22.8	23.7	27.5	24.9	23.9
3 - 5	18.3	17.9	18.3	21.4	14.6	20.7	26.0	19.9	18.2
6 - 10	6.9	4.4	7.0	7.1	8.6	7.2	8.1	11.4	8.6
11 - 15	1.5	2.4	3.2	1.5	1.6	1.5	2.8	1.7	2.6
16 - 20	1.2	0.0	1.1	0.0	0.4	0.9	0.7	0.6	1.1
over 20	1.0	1.6	0.8	1.5	1.0	0.9	1.5	0.3	1.6
Watching TV									
none	8.0	12.0	11.2	19.3	14.9	10.8	13.3	10.8	10.3
less than one	13.8	13.1	11.1	14.2	14.1	15.3	13.2	15.3	14.7
1 - 2	18.8	20.3	22.0	23.4	20.7	20.7	22.4	18.9	19.8
3 - 5	28.9	29.5	26.6	22.3	25.2	25.8	25.8	27.5	26.5
6 - 10	18.0	15.1	18.8	12.7	17.1	15.9	16.5	16.7	17.5
11 - 15	7.1	5.6	5.2	5.1	5.4	6.3	5.4	7.5	6.2
16 - 20	2.9	4.0	2.8	2.0	1.4	2.7	1.5	1.4	2.0
over 20	2.6	0.4	2.4	1.0	1.2	2.4	1.9	1.9	3.0
Commuting to Campus									
none	42.8	44.8	48.7	54.4	50.6	54.5	49.7	47.0	46.6
less than one	19.3	16.4	15.6	17.1	16.3	14.1	18.0	15.5	19.8
1 - 2	15.6	16.0	16.2	11.9	14.2	13.5	13.9	12.7	13.5
3 - 5	14.8	13.2	11.9	13.5	12.6	11.7	11.5	16.6	12.3
6 - 10	6.3	9.2	5.7	2.6	4.5	5.1	5.4	5.0	5.6
11 - 15	1.0	0.4	1.3	0.5	1.2	1.2	0.9	1.7	1.7
16 - 20	0.3	0.0	0.4	0.0	0.2	0.0	0.4	0.6	0.2
over 20	0.1	0.0	0.3	0.0	0.4	0.0	0.1	1.1	0.3
Religious Services/Meetings									
none	49.6	55.8	50.8	61.7	58.2	57.7	46.2	49.6	49.4
less than one	17.7	11.2	15.8	10.2	15.1	14.9	15.8	14.6	16.8
1 - 2	25.5	25.1	23.7	21.4	20.9	21.4	28.7	28.7	24.7
3 - 5	5.2	5.6	7.3	5.6	4.6	4.5	8.0	5.8	6.4
6 - 10	1.5	2.4	1.9	1.0	1.0	1.5	0.9	1.4	1.9
11 - 15	0.3	0.0	0.4	0.0	0.2	0.0	0.3	0.0	0.5
16 - 20	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.3
over 20	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hobbies									
none	25.7	26.6	24.7	25.9	30.8	26.1	25.0	22.3	25.0
less than one	24.6	21.0	19.8	20.8	18.5	21.0	23.6	25.4	21.7
1 - 2	27.2	29.4	27.7	32.0	26.1	25.5	26.5	27.4	28.8
3 - 5	15.2	17.5	17.8	15.2	15.4	17.4	17.7	17.0	17.1
6 - 10	4.2	2.8	6.8	5.1	7.0	3.9	4.4	5.3	5.1
11 - 15	1.5	0.8	1.5	1.0	1.0	3.0	1.3	0.8	1.0
16 - 20	0.4	1.6	0.6	0.0	0.6	0.6	0.7	0.3	0.6
over 20	1.1	0.4	1.0	0.0	0.6	2.4	0.7	1.4	0.7

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Number of Respondents	935	268	758	478	623	604	812	380	1,097
Year Graduated from High School									
1985	98.7	97.7	98.3	98.5	98.4	98.5	99.0	98.9	99.6
1984	0.6	0.4	1.1	0.8	1.0	0.3	0.5	0.8	0.4
1983	0.3	0.8	0.1	0.0	0.2	0.5	0.1	0.0	0.0
1982 or earlier	0.2	0.8	0.4	0.2	0.3	0.2	0.2	0.0	0.0
H.S. equivalency (G.E.D. test)	0.0	0.0	0.1	0.0	0.2	0.2	0.0	0.0	0.0
never completed high school	0.1	0.4	0.0	0.4	0.0	0.3	0.1	0.3	0.0
Age on December 31, 1989									
20 or younger	0.3	0.0	0.0	0.6	0.0	0.3	0.4	0.5	0.1
21	4.0	4.9	3.7	5.7	3.5	3.6	3.5	3.4	4.4
22	78.9	79.8	75.0	80.6	78.8	79.6	78.0	76.6	79.3
23	15.7	13.5	20.1	11.8	16.4	15.4	17.2	19.2	15.9
24	0.9	0.4	0.7	1.1	0.8	0.7	0.5	0.3	0.3
25-28	0.2	1.1	0.5	0.0	0.5	0.2	0.5	0.0	0.0
29-33	0.0	0.4	0.0	0.2	0.0	0.2	0.0	0.0	0.0
34-43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44-58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59 or older	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Racial Background (1)									
White/Caucasian	86.0	90.3	84.4	91.2	86.2	89.7	85.6	90.4	85.1
Black/Negro/Afro-American	4.0	1.9	8.5	3.6	7.3	5.8	4.6	3.7	7.6
American Indian	1.0	0.8	1.1	0.4	0.7	1.3	1.4	1.1	1.7
Asian-American/Oriental	8.4	6.6	4.9	4.4	5.7	3.5	6.9	4.5	5.9
Mexican-American/Chicano	1.2	1.9	2.1	0.8	1.1	0.8	1.6	1.3	2.3
Puerto Rican-American	0.2	0.4	0.3	0.2	0.2	0.5	0.2	0.0	0.8
other	1.5	1.5	0.9	1.0	1.5	1.0	1.6	1.1	2.2
Miles from Home to College									
5 or less	4.0	4.9	4.6	4.0	3.9	5.0	4.2	5.0	3.8
6 to 10	4.2	8.3	5.3	5.6	4.4	6.6	5.0	7.1	5.4
11 to 50	20.1	22.7	17.8	21.3	19.7	19.5	21.0	22.5	19.5
51 to 100	14.2	12.9	11.1	15.7	11.6	15.4	16.6	16.4	15.3
101 to 500	35.7	28.4	33.7	33.9	36.8	35.4	35.1	33.9	36.4
more than 500	21.9	22.7	27.5	19.5	23.6	18.0	18.1	15.1	19.6
Marital Status in 1985									
not presently married	99.9	100.0	99.7	99.6	99.8	100.0	100.0	100.0	99.9
married, living with spouse	0.0	0.0	0.3	0.4	0.2	0.0	0.0	0.0	0.1
married, not living with spouse	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
in 1989									
not presently married	95.0	95.9	92.7	94.3	94.4	91.7	93.8	94.2	93.8
married, living with spouse	4.8	4.1	6.8	5.5	5.5	8.3	5.7	4.7	6.1
married, not living with spouse	0.2	0.0	0.5	0.2	0.2	0.0	0.5	1.1	0.1

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Average High School Grade									
A or A+	41.7	43.2	25.3	41.5	36.6	31.7	37.6	30.2	28.9
A-	25.0	24.4	25.2	27.0	26.5	22.5	28.1	27.8	22.4
B+	18.3	13.9	22.8	18.4	18.2	20.5	19.7	18.5	24.0
B	10.8	11.3	16.4	8.8	13.2	15.2	9.9	16.9	15.5
B-	2.5	3.8	6.2	2.5	3.1	5.7	3.0	4.8	5.6
C+	1.2	2.6	3.6	1.5	1.9	2.8	1.4	1.3	2.1
C	0.5	0.4	0.5	0.2	0.5	1.5	0.5	0.5	1.4
D	0.0	0.4	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Average Undergraduate Grade									
A	11.1	12.3	5.8	17.1	15.3	9.2	13.5	10.8	9.2
B+,A-	29.3	29.1	26.8	39.8	30.8	31.1	39.9	33.2	31.4
B	36.7	34.0	36.6	28.4	33.8	38.4	30.9	38.9	37.7
C+,B-	19.6	21.6	25.0	11.8	17.6	17.3	13.0	14.7	18.6
C	3.3	3.0	5.6	2.9	2.4	3.7	2.8	2.4	3.0
C- or less	0.0	0.0	0.3	0.0	0.2	0.3	0.0	0.0	0.1
Degree Aspirations in 1985									
none	0.4	0.0	0.4	0.2	0.4	0.4	0.7	0.3	0.9
vocational certificate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
associate (A.A. or equivalent)	0.2	0.8	0.1	0.0	0.2	0.6	0.4	0.0	0.1
bachelor's (B.A.,B.S.,etc.)	22.9	22.9	24.1	19.3	20.9	25.2	10.2	19.7	9.4
master's (M.A.,M.S.,etc.)	51.1	37.1	48.2	31.1	35.7	34.4	13.2	30.5	12.7
Ph.D. or Ed.D	21.5	28.2	22.2	40.5	22.0	26.0	16.7	22.5	15.3
M.D., D.O., D.D.S. D.V.M	3.1	8.6	3.1	7.7	18.1	11.2	58.2	23.7	59.5
LL.B. or J.D. (law)	0.6	1.2	0.7	0.9	1.8	1.5	0.3	1.2	1.2
B.D. or M.Div. (divinity)	0.0	0.8	0.4	0.0	0.2	0.2	0.0	0.3	0.1
other	0.2	0.4	0.7	0.2	0.9	0.6	0.4	1.8	0.7
Highest Degree Earned by 1989									
none	33.5	43.6	33.4	15.4	18.7	25.6	17.0	29.8	21.5
vocational certificate	0.2	0.4	0.8	0.4	0.0	0.5	0.2	0.0	0.3
associate (A.A. or equivalent)	2.9	5.1	5.5	1.5	2.8	2.4	2.2	4.3	3.6
bachelor's (B.A., B.S., etc.)	63.0	49.8	59.6	81.7	77.4	71.2	79.0	65.1	73.2
master's (M.A., M.S., etc.)	0.4	0.4	0.3	0.8	0.5	0.0	1.0	0.5	0.6
Ph.D. or Ed.D	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0
M.D., D.O., D.D.S., D.V.M	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
J.D. or LL.B. (law)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B.D. or M.Div. (divinity)	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.0	0.1
other	0.0	0.8	0.3	0.2	0.5	0.2	0.1	0.3	0.7
Degree Aspirations in 1989									
none	0.4	0.0	0.5	1.1	0.5	0.5	0.6	0.0	0.5
vocational certificate	0.2	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0
associate (A.A. or equivalent)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
bachelor's (B.A., B.S., etc.)	20.4	26.4	21.7	13.2	14.4	15.3	10.0	15.6	12.7
master's (M.A., M.S., etc.)	54.4	48.3	47.2	36.4	42.5	45.1	19.3	29.9	35.5
Ph.D. or Ed.D	19.1	16.9	21.4	42.1	31.4	26.3	20.8	20.2	23.0
M.D., D.O., D.D.S., D.V.M	2.4	3.8	2.2	3.6	9.2	4.4	44.9	27.5	15.7
J.D. or LL.B. (law)	2.4	4.2	5.8	1.5	1.2	6.6	1.6	2.2	10.1
B.D. or M.Div. (divinity)	0.0	0.0	0.4	0.6	0.0	0.2	0.4	0.8	0.7
other	0.7	0.4	0.5	1.5	0.7	1.7	2.3	3.8	1.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Freshman College was Student's									
first choice	73.0	69.7	72.7	75.7	75.0	75.9	75.4	73.6	72.7
second choice	21.3	20.1	20.9	18.4	17.9	19.1	16.9	20.1	19.2
third choice	4.7	7.6	4.9	3.4	4.5	3.7	5.5	4.5	5.1
less than third choice	1.0	2.7	1.6	2.5	2.6	1.3	2.2	1.8	2.9
College Experiences Noted Very Satisfactory or Satisfactory (2)									
science and mathematics courses	87.7	82.7	77.8	90.1	86.9	72.5	86.9	85.4	72.9
humanities courses	68.0	66.8	72.2	74.5	73.4	78.5	79.0	74.0	83.8
social science courses	59.8	62.4	67.1	64.2	62.9	74.1	68.7	68.4	78.1
courses in major field	86.8	85.1	81.8	87.4	86.2	85.7	88.1	86.0	87.2
general education requirements	64.9	64.6	67.3	70.6	68.0	66.7	73.0	66.4	72.5
relevance of coursework to life	51.3	53.0	51.1	56.4	53.7	50.6	57.2	52.1	59.0
overall quality of instruction	75.9	76.3	76.6	86.3	82.8	79.4	81.1	79.4	84.8
lab facilities and equipment	62.8	66.9	69.9	70.8	73.0	64.8	72.6	74.5	73.7
library facilities	68.9	71.1	73.4	69.9	67.1	73.0	67.9	72.9	71.1
computer facilities	74.3	71.8	74.0	75.8	75.7	71.7	74.6	71.3	72.0
oppty for interdisciplin courses	48.7	54.5	57.5	67.9	60.4	61.0	68.3	62.1	65.6
oppty to talk to professors	78.0	77.2	77.6	88.7	82.9	82.9	81.9	82.5	83.9
oppty for extracurr activities	79.2	73.9	79.0	83.0	81.5	81.5	81.2	79.8	82.7
campus social life	53.5	51.9	53.8	60.5	56.8	62.1	62.2	60.9	62.9
regulations on campus life	40.3	44.3	41.4	47.0	43.1	46.3	49.2	49.2	45.9
academic tutoring or assistance	57.7	57.5	63.8	64.4	71.0	57.6	62.3	60.2	63.7
academic advising	42.9	40.6	47.3	53.7	55.6	49.7	55.0	47.5	51.9
career counseling and advising	44.0	42.2	43.8	46.6	46.6	47.6	47.1	42.1	46.1
personal counseling	38.5	36.7	46.2	46.8	47.3	50.6	48.8	44.8	49.2
student housing	55.6	51.6	57.9	61.4	62.1	59.7	59.4	56.0	61.2
financial aid services	48.9	44.5	49.0	57.9	52.3	52.4	50.2	48.8	53.5
contact with faculty and admin	64.1	58.6	65.2	77.3	74.2	70.1	70.9	70.6	74.6
relations with faculty & admin	64.6	59.1	63.8	74.0	73.3	71.7	71.7	69.6	74.1
oppty to attend films,concerts	68.3	71.1	70.1	77.8	72.2	74.7	75.4	78.2	76.9
job placement services	64.7	63.9	48.1	47.7	47.9	48.7	44.3	43.7	44.5
campus health services	62.6	61.6	61.2	54.2	55.9	58.5	51.3	49.1	54.9
overall college experience	83.1	80.4	77.6	89.2	84.4	83.5	85.0	82.7	85.0
Enroll at Freshman College Again									
definitely yes	38.9	32.5	36.8	43.0	40.8	40.7	41.9	37.8	40.8
probably yes	38.9	35.1	31.0	39.0	36.5	32.8	35.4	34.0	33.3
don't know	3.8	6.4	4.9	4.9	4.4	2.8	4.8	3.7	3.6
probably not	13.0	16.6	18.1	8.9	12.9	14.9	13.0	17.8	15.0
definitely not	5.4	9.4	9.2	4.2	5.5	8.7	4.8	6.6	7.4

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Student Took Time Off, Withdrew or Transferred									
no	86.0	76.9	69.5	88.2	82.0	75.3	85.7	72.5	76.8
transferred	8.6	16.7	21.1	6.5	12.0	16.4	10.3	17.1	15.8
withdrew	0.9	1.5	3.3	1.1	1.5	2.2	2.0	3.5	2.0
leave of absence	4.5	4.9	6.0	4.2	4.5	6.0	2.0	7.0	5.4
Reasons Noted as Very Important for Taking Time Off (3)									
reconsider goals & interests	34.1	48.4	46.1	21.1	40.2	48.3	34.2	51.5	45.5
changed career plans	20.8	40.6	42.9	17.9	30.6	37.6	23.7	38.8	36.8
wanted practical experience	25.6	17.2	10.7	8.9	11.8	13.4	24.3	15.5	16.0
didn't "fit in"	14.7	18.7	17.3	21.4	20.9	17.4	17.5	10.7	18.0
was bored with course work	7.0	9.4	16.0	12.5	13.5	12.8	12.3	6.8	10.4
wanted better acad. reputation	16.4	21.9	11.5	12.5	11.6	16.1	21.9	11.7	13.6
wanted better social life	12.5	9.4	14.7	14.5	10.0	14.1	14.0	10.7	14.1
wanted to be closer to home	7.1	4.7	6.2	12.3	11.7	12.1	9.6	4.9	10.8
had good job offer	9.6	12.5	5.3	5.4	6.4	3.4	1.8	4.9	3.2
wasn't doing well academically	15.7	17.2	27.3	21.4	20.7	19.5	18.4	12.6	19.5
family responsibilities	6.3	3.1	5.3	1.8	9.0	4.0	7.0	12.6	7.2
tired of being student	5.5	4.7	2.7	9.1	2.7	5.4	7.0	3.9	5.2
couldn't afford college	15.0	14.1	12.0	14.3	15.2	11.4	18.1	9.7	17.3
wanted wider course selection	27.6	28.1	24.8	12.7	21.2	26.8	33.0	27.2	25.0
ENROLLMENT STATUS									
First Year									
attended first college full-time	99.2	98.9	99.3	99.8	99.7	99.7	99.6	98.4	99.2
attended first college part-time	0.4	1.1	0.3	0.0	0.0	0.2	0.4	0.3	0.3
attended diff college full-time	0.3	0.0	0.3	0.2	0.3	0.2	0.0	1.3	0.6
attended diff college part-time	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
not enrolled	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Second Year									
attended first college full-time	94.7	87.2	83.5	94.9	91.9	87.0	93.4	86.1	88.8
attended first college part-time	0.5	2.1	2.3	0.2	0.5	2.0	0.9	1.4	1.4
attended diff college full-time	4.2	7.4	11.4	4.2	6.2	8.9	4.9	8.8	8.0
attended diff college part-time	0.5	1.6	1.3	0.4	1.0	0.9	0.5	2.0	1.4
not enrolled	0.1	1.6	1.6	0.2	0.3	1.2	0.3	1.7	0.4
Third Year									
attended first college full-time	89.0	77.1	76.3	90.7	85.4	79.5	87.9	77.8	81.3
attended first college part-time	1.3	3.7	1.9	0.2	1.2	1.2	0.8	1.7	1.2
attended diff college full-time	8.5	14.7	19.0	7.1	10.9	15.0	10.0	17.3	14.6
attended diff college part-time	0.8	1.6	0.6	0.7	0.8	1.8	0.9	1.7	2.1
not enrolled	0.5	2.9	2.3	1.3	1.7	2.5	0.4	1.4	0.8
Fourth Year									
attended first college full-time	87.6	78.4	77.1	90.6	85.4	82.0	86.6	79.0	84.5
attended first college part-time	1.1	2.0	1.3	1.3	1.9	0.7	1.2	2.0	1.0
attended diff college full-time	9.6	16.3	18.2	6.8	11.0	15.4	10.5	16.4	12.9
attended diff college part-time	0.8	0.8	1.3	0.9	1.0	0.9	0.8	1.4	0.9
not enrolled	0.9	2.4	2.1	0.4	0.7	0.9	0.9	1.1	0.7

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Have Met or Exceeded Recommended Years of High School Study (4)									
English (4 years)	98.0	96.1	95.3	96.8	96.6	96.4	97.5	95.8	97.1
mathematics (3 years)	99.6	99.1	98.5	98.1	99.5	98.8	97.7	96.9	97.1
foreign language (2 years)	85.3	78.8	82.0	85.4	87.2	82.5	87.1	80.8	84.8
physical science (2 years)	85.0	82.7	77.2	87.2	80.1	75.6	78.1	71.2	73.9
biological science (2 years)	27.9	30.4	27.7	27.8	35.4	30.2	66.6	56.5	64.0
history or Am gov (1 year)	99.2	99.6	99.2	100.0	98.8	99.7	99.6	100.0	99.6
computer science (1/2 year)	77.3	75.3	70.9	79.4	73.0	74.6	62.0	60.2	60.6
art or music (1 year)	52.3	54.7	56.7	61.3	57.0	55.8	59.7	63.1	63.2
Number of Undergraduate Courses Taken Which Emphasize:									
Writing Skills									
none	4.0	3.7	2.5	4.2	2.4	2.5	1.4	2.9	0.8
1 to 2	46.4	40.4	27.9	37.6	35.8	32.1	35.1	36.6	27.2
3 to 5	38.0	44.9	45.8	38.2	42.9	36.2	42.6	42.1	34.5
6 to 8	7.8	7.1	11.5	10.7	10.9	12.3	10.6	10.5	14.7
9 or more	3.8	3.7	12.3	9.2	8.0	16.9	10.3	7.9	22.8
Math/Understanding Numbers									
none	0.0	0.0	0.1	0.2	0.2	0.8	1.0	0.8	1.2
1 to 2	0.1	2.6	6.1	1.5	4.2	16.4	24.5	19.5	29.8
3 to 5	10.5	12.7	33.9	18.1	20.9	37.2	51.5	48.4	41.5
6 to 8	27.3	23.6	23.1	15.8	16.5	16.9	14.0	19.5	13.3
9 or more	62.1	61.0	36.7	64.5	58.3	28.6	9.0	11.8	14.2
Science/Scientific Inquiry									
none	0.1	1.1	0.5	0.4	0.5	0.8	0.0	0.0	0.3
1 to 2	1.1	2.2	12.3	11.1	9.0	24.5	0.7	2.4	13.4
3 to 5	9.7	15.4	31.7	22.1	17.4	33.1	2.5	6.3	31.1
6 to 8	20.7	18.7	18.6	9.9	15.0	11.6	4.8	7.7	16.4
9 or more	68.4	62.5	36.9	56.5	58.2	30.0	92.0	83.6	38.8
History/Historical Analysis									
none	20.6	10.9	7.0	10.8	10.9	7.8	11.0	10.6	6.9
1 to 2	46.9	53.6	40.3	50.0	48.0	44.1	55.7	53.3	45.5
3 to 5	28.9	32.2	38.4	34.0	34.0	33.1	29.4	32.5	32.8
6 to 8	3.1	2.6	9.9	5.3	6.3	7.7	2.8	3.2	7.6
9 or more	0.5	0.7	4.4	0.0	0.8	7.3	1.1	0.5	7.2
Foreign Language Skills									
none	76.6	60.9	49.3	34.6	41.3	39.3	41.8	41.1	35.7
1 to 2	16.0	25.2	27.9	38.0	34.4	31.8	35.4	32.1	31.7
3 to 5	6.2	9.0	16.5	22.2	17.8	22.3	20.5	22.1	22.5
6 to 8	0.9	3.8	4.8	3.8	4.5	2.7	1.7	2.9	6.3
9 or more	0.3	1.1	1.6	1.5	1.9	4.0	0.6	1.8	3.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Events Considered Very Likely to Occur (in 1985)									
be elected to student office	2.6	2.0	4.5	1.7	4.5	3.7	3.5	4.1	5.3
be satisfied with college	61.9	51.8	61.5	66.8	67.0	63.6	66.2	59.8	67.9
change career choice	6.5	27.0	12.0	17.6	21.1	21.4	9.9	24.3	13.6
change major field	7.8	28.4	12.6	11.0	20.1	19.1	8.5	25.7	12.3
drop out permanently	0.2	1.0	0.1	0.0	0.2	0.9	0.3	0.0	0.3
drop out temporarily	0.3	0.5	0.4	0.0	0.2	0.7	0.4	0.0	0.7
get job to pay expenses	38.3	46.4	38.2	46.4	40.8	44.7	40.5	47.0	40.6
get married while in college	1.9	5.7	1.8	1.9	2.3	2.2	3.3	2.0	4.0
graduate with honors	23.5	23.4	20.2	27.1	23.7	20.8	24.5	15.3	21.7
join social frat or sorority	20.3	23.6	20.0	16.8	21.3	20.5	25.2	19.4	25.6
make at least "B" average	56.5	58.2	49.2	64.5	58.1	53.0	62.8	51.9	58.8
participate in student protests	2.9	4.6	3.3	4.9	5.7	5.7	4.8	5.0	6.9
play varsity athletics	15.4	16.4	20.9	17.0	21.6	20.5	16.0	15.0	18.1
transfer to another college	6.5	9.7	13.3	3.8	7.2	6.7	4.8	8.7	8.6
work at outside job	12.3	18.5	15.5	15.3	15.8	18.5	13.9	17.4	16.0
work full-time while attending	2.2	4.6	3.7	2.8	2.9	2.5	0.6	0.6	1.6
Events Occurring by 1989									
elected to student office	23.3	25.4	23.5	20.6	24.7	25.0	24.2	22.6	28.4
satisfied with freshman coll (5)	82.8	79.5	77.3	88.5	84.1	82.9	84.5	81.8	84.8
changed career choice (5)	24.6	61.4	82.1	52.7	69.5	71.7	47.6	69.9	80.2
changed major field (5)	0.0	100.0	100.0	14.2	93.3	93.6	35.3	98.8	98.7
dropped out permanently (5)	0.9	1.5	3.3	1.0	1.4	2.2	2.0	3.4	2.0
dropped out temporarily (5)	4.5	4.9	5.9	4.2	4.5	6.0	2.0	6.8	5.3
got part-time job on campus	54.4	54.9	52.1	76.0	68.7	62.0	66.4	71.7	67.1
got married	4.8	4.1	6.7	5.5	5.0	7.9	6.0	5.7	5.8
graduated with honors	27.8	25.7	16.4	43.5	32.7	25.8	34.9	25.4	24.8
joined social frat or sorority	26.2	27.0	23.0	18.2	20.1	23.9	28.4	23.7	28.9
made at least "B" average (5)	77.1	75.4	69.1	85.3	79.9	78.7	84.2	82.9	78.3
participated in student protests	12.2	11.6	19.9	22.7	23.3	24.8	22.6	22.0	26.6
played intercollegiate athletics	28.0	28.2	33.1	27.9	33.1	30.6	28.2	32.0	31.1
transferred before grad (5)	8.6	16.4	20.8	6.5	11.9	16.2	10.2	16.8	15.6
worked part-time job off-campus	45.3	54.9	55.0	47.7	49.5	58.1	56.8	64.6	61.6
worked full-time while student	9.4	16.1	15.5	7.0	10.2	14.2	8.7	7.8	12.3
Other College Activities									
assisted faculty teaching class	14.1	15.7	18.7	33.5	33.3	17.5	28.3	26.4	21.1
attended racial awareness wkshop	13.3	14.2	23.1	26.2	26.5	23.6	28.4	24.7	34.7
enrolled in ethnic stud course	10.7	13.1	27.6	24.0	27.2	27.4	26.3	27.0	36.9
enrolled in honors program	53.6	57.6	48.5	71.9	66.5	51.2	64.1	57.4	53.1
enrolled in interdisc course	58.7	59.8	61.3	64.4	65.0	55.6	65.5	62.4	61.5
enrolled in women's stud course	3.5	3.0	10.9	11.1	12.6	14.5	14.3	14.3	23.2
in college internship program	30.0	33.0	24.3	22.8	22.3	27.6	21.9	29.2	29.1
in study abroad program	4.5	2.3	7.8	12.3	9.7	13.2	10.3	11.1	15.9
played intercoll foot/basketball	5.4	6.0	6.6	4.5	5.8	6.1	5.6	6.5	5.4
purchased a personal computer	33.3	27.0	29.0	26.6	26.0	23.6	19.5	19.2	22.3
taken reading study/skills class	9.0	11.2	16.7	9.7	12.3	16.5	11.9	12.2	17.4
taken remedial/develop course	3.4	4.5	6.6	2.3	4.1	7.1	4.6	6.5	6.2
voted in 1988 election	70.6	69.4	71.8	71.1	68.7	71.5	70.8	70.3	71.9
worked on prof's research proj	28.8	28.9	23.8	36.7	38.1	24.2	47.7	35.8	29.3

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Activities in the Past Year									
Reported in 1985									
attended recital or concert	75.9	78.7	81.0	80.2	81.5	80.1	83.6	83.9	87.3
drank beer	66.1	60.2	66.8	52.2	57.8	59.4	56.8	64.7	62.0
felt depressed (6)	7.0	6.7	7.0	8.0	8.2	6.3	6.4	9.0	10.2
felt overwhelmed (6)	14.0	13.0	15.3	14.1	18.2	16.5	17.0	20.1	19.3
missed school due to illness (6)	1.2	2.7	3.2	1.9	3.3	2.8	3.7	2.1	4.9
smoked cigarettes (6)	1.1	2.7	2.8	1.7	2.8	3.7	2.0	4.5	3.9
stayed up all night	67.5	67.3	70.7	67.2	67.8	70.3	68.2	73.3	72.4
tutored another student	69.7	65.1	65.0	71.9	70.0	66.2	63.3	62.5	63.8
was guest in teacher's home	31.1	36.4	33.4	37.2	38.9	37.7	36.6	40.8	38.8
Reported in 1989									
attended recital or concert	66.7	66.4	72.5	73.4	74.6	74.8	76.2	77.2	77.6
didn't complete homework on time	63.9	60.9	60.7	56.7	58.0	53.0	42.6	42.9	48.2
discuss course content w/std (6)	67.8	68.8	57.4	62.9	60.6	58.6	61.3	60.1	62.2
discuss political/soc issues (6)	26.6	28.9	38.0	36.1	36.9	40.0	35.2	33.7	43.9
discuss racial/ethnic issues (6)	6.9	5.3	10.8	10.1	12.3	15.3	14.3	10.3	19.7
drank beer	79.4	71.4	78.2	69.2	73.7	72.7	70.8	72.7	72.9
drank wine or liquor	76.6	71.8	77.4	73.4	76.4	77.3	79.5	78.7	82.0
felt depressed (6)	10.6	13.5	13.0	11.9	11.0	11.0	11.6	11.7	11.4
felt like leaving college	25.9	30.1	32.4	21.8	27.6	28.3	23.0	28.6	27.4
felt overwhelmed (6)	33.6	34.2	31.9	25.4	32.3	29.2	28.6	31.1	29.4
gave a presentation in class (6)	12.8	10.9	16.5	13.0	13.9	18.3	12.4	11.6	19.7
missed class due to illness (6)	0.9	1.1	2.0	0.4	1.0	1.5	1.2	1.6	1.4
paper critiqued by instructor(6)	19.2	20.0	39.0	24.9	30.9	41.5	32.4	29.1	47.6
participated in intramural sport	62.9	54.5	57.6	48.0	54.5	49.2	51.0	49.2	47.6
read the student newspaper (6)	56.6	63.8	56.9	59.3	59.4	61.4	64.1	63.0	64.2
received personal counseling	8.2	6.4	14.1	11.9	12.9	16.0	11.1	16.9	14.7
received tutoring in courses	24.0	25.9	27.4	17.0	23.9	18.8	18.4	19.8	18.6
received vocational counseling	52.0	47.0	57.4	58.5	57.7	60.2	55.5	58.5	59.9
smoked cigarettes (6)	1.5	2.3	5.5	4.4	3.6	6.2	3.1	6.1	7.4
social with diff ethnic grp (6)	41.6	41.4	41.9	49.6	42.1	47.7	48.4	38.6	47.9
stayed up all night	65.9	69.9	65.5	56.6	61.7	63.3	56.5	61.0	62.9
took a multiple-choice exam (6)	16.5	19.2	45.9	23.1	29.2	42.5	44.8	48.9	45.0
took an essay exam (6)	17.6	18.4	49.2	36.3	42.6	55.3	54.0	52.5	59.6
took pt in campus demonstration	9.7	10.2	15.9	18.3	18.3	21.5	16.7	17.2	21.8
tutored another student	65.2	66.5	67.2	76.7	77.5	62.7	62.9	61.4	61.1
was guest in professor's home	22.8	22.6	31.7	41.5	46.0	36.6	41.3	39.3	41.6
worked on grp proj for class (6)	51.8	46.6	30.6	19.5	23.5	28.0	17.0	16.7	25.0
worked on ind research project	55.3	51.3	53.7	57.9	60.0	55.1	59.8	53.1	56.4

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Student Rated Self Above Average or Highest 10%									
in 1985									
academic ability	95.1	90.5	91.1	93.5	92.5	86.0	91.2	85.2	86.7
artistic ability	26.6	31.0	25.7	25.6	25.6	18.7	24.1	23.9	27.1
drive to achieve	82.6	75.5	79.8	82.4	80.7	77.7	83.9	74.9	79.5
emotional health	67.3	65.2	69.8	61.8	64.3	66.4	64.6	61.4	67.9
leadership ability	62.6	58.5	63.1	56.1	59.7	58.6	59.7	55.3	63.0
mathematical ability	92.6	87.3	84.6	90.7	86.1	79.2	70.9	65.1	58.8
physical health	70.3	67.1	70.0	61.3	60.7	64.1	67.2	63.2	64.2
popularity	37.5	41.3	46.9	32.7	36.4	43.2	41.0	39.8	44.6
self-confidence (intellectual)	76.4	75.0	72.6	78.7	74.5	71.2	73.8	67.7	69.9
self-confidence (social)	41.5	40.5	48.7	37.4	40.5	46.2	42.7	41.5	46.6
writing ability	49.9	48.2	51.2	51.9	50.6	48.9	55.4	49.5	52.6
in 1989									
academic ability	91.7	89.5	88.3	92.9	89.4	87.2	90.6	85.8	84.2
artistic ability	26.1	35.1	28.9	29.3	28.9	28.7	28.4	26.7	30.9
drive to achieve	79.7	78.3	75.6	76.2	74.6	73.7	81.8	74.5	76.1
emotional health	62.5	57.8	62.1	60.4	62.6	60.7	62.3	60.7	62.4
leadership ability	69.8	64.2	69.8	60.3	63.9	61.9	63.0	59.4	67.5
mathematical ability	93.0	91.4	77.3	89.1	85.9	67.3	64.3	61.2	50.5
physical health	64.9	65.3	64.8	59.4	60.5	60.4	64.8	64.6	58.0
popularity	42.0	39.6	45.8	35.8	39.2	44.0	43.9	42.7	49.8
self-confidence (intellectual)	80.7	75.7	77.1	79.3	76.4	77.2	76.3	70.9	74.5
self-confidence (social)	46.7	41.4	53.4	39.7	47.4	53.0	48.7	48.1	55.6
writing ability	54.5	61.2	60.8	60.7	56.2	62.7	60.3	57.3	66.4
listening ability	68.3	64.9	72.0	71.5	72.7	74.6	78.3	72.8	79.7
Students Reporting Much Stronger Abilities and Skills in 1989									
general knowledge	47.6	48.7	52.1	48.5	48.8	49.8	52.9	52.0	55.5
problem-solving skills	59.9	57.7	39.6	52.9	52.8	35.4	37.7	33.9	36.7
knowledge of particular field	71.1	74.5	61.6	73.9	66.8	68.5	72.6	63.5	68.2
critical thinking ability	41.3	39.8	39.6	42.2	41.8	40.4	39.3	38.8	43.7
writing skills	10.7	14.2	22.2	17.4	19.9	26.0	17.3	17.4	28.0
foreign language ability	2.8	6.4	8.8	8.4	8.7	10.3	6.8	9.2	12.0
job-related skills	39.9	46.4	31.4	30.0	26.7	31.1	20.2	19.3	25.3
religious beliefs & convictions	8.0	9.1	13.9	11.6	10.9	9.0	9.9	8.9	11.2
interest in grad/prof school	26.2	31.5	29.7	27.3	35.1	32.3	37.6	45.8	38.3
preparation for grad/prof school	30.0	29.4	24.3	35.4	34.2	30.1	45.1	39.3	33.6
leadership abilities	31.4	25.5	33.8	23.9	30.8	27.7	23.4	24.5	32.7
ability to work independently	30.6	28.5	34.2	30.7	36.0	35.2	32.1	34.2	39.1
interpersonal skills	29.8	25.5	31.9	29.0	33.1	31.0	32.9	27.2	37.9
cultural awareness	20.0	21.8	26.4	26.9	29.7	30.7	32.9	30.6	39.6
acceptance of dif races/cultures	16.5	19.2	20.8	17.6	25.8	24.0	25.4	25.7	30.0
competitiveness	18.9	15.1	21.9	10.1	17.5	14.3	12.3	13.7	14.6
confidence in academic abilities	24.6	25.9	23.8	20.8	24.4	23.6	19.9	24.2	24.0
public speaking ability	19.1	17.2	22.8	18.9	19.3	21.1	16.9	16.3	20.9
ability to work cooperatively	19.9	19.5	21.0	15.8	19.0	19.1	16.5	17.4	23.4

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
LIVING ARRANGEMENTS									
Preferred for Fall 1985									
with parents or relatives	11.5	14.2	11.0	8.9	10.8	10.0	12.4	9.0	9.1
other private home,apt,room	16.9	22.6	21.7	10.3	16.1	17.5	14.5	21.7	17.3
college dormitory	59.0	52.7	54.2	72.2	64.0	59.6	62.7	59.1	64.0
fraternity or sorority house	6.3	4.6	7.0	3.1	4.4	6.0	5.0	4.6	5.1
other campus housing	5.6	4.2	5.2	4.8	4.4	5.2	4.9	4.3	3.5
other	0.7	1.7	0.9	0.7	0.2	1.7	0.4	1.2	1.1
Planned for Fall 1985									
with parents or relatives	13.7	19.1	17.0	13.3	11.9	13.2	13.6	16.8	13.2
other private home,apt,room	1.6	1.9	1.5	1.5	1.3	1.7	1.2	1.3	0.9
college dormitory	81.9	76.3	78.9	82.3	84.4	81.7	82.6	80.0	83.3
fraternity or sorority house	0.3	0.4	0.8	0.2	0.3	0.0	0.5	0.8	0.4
other campus housing	2.3	2.3	1.6	2.5	1.8	3.1	1.4	0.5	2.0
other	0.1	0.0	0.3	0.2	0.3	0.3	0.7	0.5	0.3
First Year									
with parents or relatives	13.9	18.9	17.3	13.4	11.9	15.4	13.0	15.6	12.7
other private home,apt,room	0.9	1.9	2.9	1.7	1.6	1.5	2.0	1.6	1.6
college dormitory	81.7	76.5	77.4	83.2	84.5	81.2	82.4	80.9	83.9
frat or sorority house	1.7	0.8	1.0	0.6	0.2	0.5	0.9	0.8	0.5
other campus student housing	1.7	1.5	1.2	1.1	1.8	1.4	1.8	0.8	1.0
other	0.1	0.4	0.3	0.0	0.0	0.0	0.0	0.3	0.2
Second Year									
with parents or relatives	13.6	18.8	19.6	13.8	13.7	14.9	11.9	16.0	13.5
other private home,apt,room	9.6	12.7	12.5	6.9	8.2	12.0	14.4	14.1	12.4
college dormitory	63.9	54.2	58.2	66.7	68.7	62.7	62.9	57.7	62.3
frat or sorority house	7.9	8.1	5.9	4.7	3.6	4.5	4.4	4.7	5.2
other campus student housing	4.8	5.4	3.4	7.5	5.1	5.5	6.1	6.6	5.8
other	0.2	0.8	0.4	0.4	0.7	0.3	0.3	0.8	0.8
Third Year									
with parents or relatives	11.1	16.4	15.5	13.3	13.2	15.3	12.2	15.5	12.9
other private home,apt,room	27.4	24.6	30.2	18.2	22.9	27.9	30.6	31.1	28.7
college dormitory	42.2	41.4	42.0	51.5	51.2	41.7	42.3	40.5	43.3
frat or sorority house	10.3	8.6	6.3	6.2	4.1	5.6	4.8	4.3	7.0
other campus student housing	8.5	7.0	4.9	10.1	7.6	8.0	9.4	8.3	7.1
other	0.5	2.0	1.0	0.6	1.0	1.5	0.8	0.3	1.1
Fourth Year									
with parents or relatives	9.4	16.3	15.7	12.7	12.1	15.3	13.7	18.0	13.4
other private home,apt,room	38.1	36.2	38.0	29.0	31.6	37.4	40.7	39.3	37.9
college dormitory	33.3	30.7	35.4	41.0	42.1	31.4	29.5	31.0	32.4
frat or sorority house	9.4	8.2	4.6	5.6	4.5	5.4	4.1	4.2	6.1
other campus student housing	8.6	6.2	5.3	10.9	9.1	9.0	11.1	6.9	8.7
other	1.2	2.3	1.0	0.9	0.7	1.6	0.9	0.6	1.5

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
College Attributes Noted as Very Descriptive									
easy to see fac outside off hrs	33.3	28.8	38.1	50.9	52.7	39.7	43.6	46.0	46.9
great conformity among students	28.9	31.2	34.4	24.4	29.1	24.6	23.1	24.3	27.8
most students very bright	47.9	48.9	46.3	40.1	44.1	42.6	40.5	42.4	46.0
admin open about policies	15.3	14.0	17.5	13.2	17.3	14.5	13.5	14.9	14.0
keen competition for grades	46.6	42.5	40.2	28.6	33.3	32.4	32.3	31.5	33.8
courses more theoret than prac	35.2	33.2	29.7	27.5	23.7	28.8	19.3	20.7	25.3
fac rewarded for advising skills	4.9	2.7	7.2	6.2	6.7	5.3	6.1	5.4	7.3
little std contact out of class	4.5	6.0	5.7	4.4	4.2	4.9	2.6	5.6	4.7
faculty at odds with admin	4.5	1.9	5.2	6.4	7.3	4.9	5.9	7.3	5.8
intercoll sports overemphasized	7.2	8.3	11.5	7.4	8.9	8.8	9.1	11.4	8.7
classes usually informal	23.7	19.2	21.1	33.9	30.0	27.8	28.4	31.0	29.7
faculty respect each other	41.7	38.4	44.5	47.6	52.8	47.9	49.8	48.5	50.2
most stdnts treated like numbers	12.8	18.0	17.6	7.4	9.0	10.5	10.3	14.1	9.4
social activities overemphasized	4.3	6.8	5.5	5.3	5.7	6.3	5.1	5.6	6.7
little contact between students	5.8	4.5	6.2	3.2	3.7	3.0	3.3	3.7	3.2
student body apathetic	25.1	26.4	19.0	22.3	20.6	20.1	20.3	22.9	17.5
stdnts don't socialize regularly	2.9	3.8	2.8	1.5	1.6	2.0	1.1	2.4	3.2
fac rewarded for good teaching	12.3	9.2	13.7	18.0	19.2	13.4	18.1	15.4	18.2
Plans for Fall 1989									
attend college full-time	37.6	49.6	42.6	16.7	22.2	31.8	18.3	35.0	28.6
attend college part-time	2.2	1.9	3.8	3.3	3.9	2.5	2.8	4.7	3.8
attend graduate school	19.6	15.7	12.9	36.6	30.7	18.2	47.2	33.4	28.1
attend vocational program	1.4	1.5	1.2	0.2	1.3	0.2	0.5	0.5	0.5
work full-time	41.4	33.2	39.4	42.1	43.8	48.5	32.8	28.9	43.3
work part-time	15.7	24.6	23.9	16.5	18.9	19.4	16.9	25.0	23.7
serve in Armed Forces	11.9	6.7	13.7	5.0	9.0	3.3	1.6	2.4	0.8
travel	1.9	2.6	3.7	2.1	3.9	4.1	3.7	3.4	5.5
do volunteer work	4.0	2.6	5.7	5.0	5.3	7.1	9.2	10.8	9.3
stay at home	2.5	2.6	4.2	3.8	4.3	3.6	3.4	3.9	4.3
Permission to Use I.D. in 1985									
yes	83.7	87.3	81.9	82.7	82.6	85.9	82.2	83.8	80.3
no	16.3	12.7	18.1	17.3	17.4	14.1	17.8	16.2	19.7
in 1989									
yes	73.3	74.4	74.0	79.1	79.5	78.6	75.5	72.7	73.5
no	26.7	25.6	26.0	20.9	20.5	21.4	24.5	27.3	26.5

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Personal Objectives Noted as Very Important or Essential in 1985									
achieve in a performing art	5.9	10.7	8.4	9.1	10.4	9.0	8.7	8.4	10.0
be expert on finance/commerce	16.4	17.3	17.5	10.8	15.4	18.7	7.9	14.2	10.8
be involved in environ cleanup	21.3	17.3	19.3	21.7	20.2	18.4	26.4	23.3	25.3
be successful in own business	36.2	39.6	38.1	24.9	35.8	36.2	43.1	40.9	45.8
be very well off financially	68.4	67.9	70.9	55.0	62.2	65.0	57.9	59.9	61.8
become authority in my field	70.0	71.9	73.1	71.2	70.2	74.7	73.3	70.2	73.1
create artistic work	6.0	12.8	6.0	5.9	6.9	7.0	6.0	11.3	8.4
develop philosophy of life	45.5	36.9	47.5	46.4	49.9	44.1	52.3	48.1	50.4
have admin responsibility	42.1	34.0	40.6	29.0	34.5	39.8	27.9	29.9	30.4
help others in difficulty	51.8	50.3	53.6	55.3	63.6	58.9	70.1	67.1	74.4
influence political structure	11.7	13.1	17.1	11.0	13.9	13.6	11.2	13.6	12.3
influence social values	21.5	21.9	25.5	21.4	26.9	27.9	25.8	30.7	29.0
obtain recog from colleagues	56.7	59.6	55.8	55.3	52.8	60.0	56.2	53.8	59.0
participate in community action	16.8	17.3	21.5	19.0	21.7	21.1	25.5	24.9	28.6
promote racial understanding	27.8	29.9	34.1	32.9	35.8	30.8	36.3	32.8	39.7
raise a family	69.4	65.0	71.8	62.6	70.5	69.4	70.7	68.8	71.1
theoretical contrib to science	31.1	35.4	31.8	43.6	28.7	30.2	40.7	24.6	37.8
write original works	7.5	10.2	7.6	10.6	7.9	11.1	8.5	12.1	11.1
in 1989									
achieve in a performing art	5.6	10.1	8.6	6.9	6.9	7.7	6.8	7.7	9.1
be expert on finance/commerce	16.5	15.7	27.4	9.1	12.1	19.8	7.3	6.1	16.9
be involved in environ cleanup	34.0	35.6	33.9	31.3	37.5	38.4	45.5	50.8	40.9
be successful in own business	34.3	37.8	42.5	17.5	27.1	30.3	30.9	30.5	37.5
be very well off financially	59.8	63.7	59.4	42.2	49.7	52.6	44.1	47.1	54.6
become authority in my field	63.8	64.4	69.7	62.2	64.3	67.9	70.2	69.7	65.1
create artistic work	6.3	12.0	11.5	8.4	7.6	10.3	8.9	11.9	11.6
develop philosophy of life	50.4	46.1	54.0	50.5	55.6	56.0	60.1	59.5	59.1
have admin responsibility	47.6	49.1	50.3	30.4	36.9	46.7	31.1	34.8	39.1
help others in difficulty	53.7	55.1	61.3	57.5	63.0	67.1	75.6	70.9	73.5
influence political structure	13.5	19.5	22.0	11.3	15.1	23.8	15.4	16.1	23.1
influence social values	29.2	29.4	40.1	33.6	35.9	45.4	43.2	42.0	52.1
obtain recog from colleagues	47.5	56.9	48.1	49.3	49.2	50.9	53.6	52.8	51.6
participate in community action	23.2	20.2	26.6	20.5	28.7	31.5	36.8	34.7	39.7
promote racial understanding	25.0	26.7	33.9	27.4	36.5	38.8	39.0	36.2	47.3
raise a family	69.2	66.3	67.4	58.9	68.4	70.7	72.5	69.6	69.7
theoretical contrib to science	24.4	29.3	17.3	36.6	33.8	15.3	42.4	37.7	19.4
write original works	7.0	11.6	14.7	12.2	11.8	14.8	9.9	11.1	16.1

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Political Orientation in 1985									
far left	1.6	1.3	0.9	1.7	1.2	1.5	1.4	1.9	1.3
liberal	20.2	19.9	22.1	25.9	26.8	22.0	25.9	26.3	26.1
middle of the road	45.6	46.2	45.4	46.3	45.4	52.2	48.5	52.3	46.0
conservative	30.5	30.9	29.2	25.1	25.0	23.6	23.0	17.9	25.5
far right	2.1	1.7	2.3	1.1	1.6	0.7	1.3	1.6	1.1
in 1989									
far left	0.5	0.4	1.6	2.4	2.3	2.7	1.4	3.2	2.6
liberal	17.8	23.4	23.5	29.6	31.0	30.8	32.4	27.1	32.3
middle of the road	38.8	31.7	37.2	39.1	39.4	39.9	38.3	45.5	38.7
conservative	41.1	42.3	36.4	28.5	26.6	26.0	27.5	23.7	25.7
far right	1.7	2.3	1.2	0.4	0.8	0.7	0.5	0.5	0.7
Agrees Strongly/Somewhat in 1985									
abolish death penalty	20.1	22.3	22.3	24.2	30.2	26.7	25.6	29.2	30.4
abortion should be legalized	55.2	57.7	56.7	55.1	58.2	59.2	54.1	61.9	59.7
busing OK to achieve balance	39.5	33.8	41.9	45.7	46.7	46.6	47.3	48.9	48.6
college ban extreme speakers	21.3	24.9	21.1	19.4	15.5	20.5	20.4	19.2	18.3
college raises earning power	67.8	68.5	68.4	56.7	58.9	59.5	54.8	60.4	58.5
college regulate off-campus acts	11.6	15.6	9.7	11.2	11.9	12.7	10.6	10.6	12.0
equal opportunity for women	93.2	92.0	92.4	94.4	94.2	95.1	95.7	96.7	95.0
gov't not controlling pollution	78.4	74.6	77.7	79.8	81.5	80.8	83.4	82.8	81.3
gov't not promoting disarmament	58.8	59.7	58.4	65.7	67.7	68.0	70.5	75.8	73.8
high school grading too easy	61.5	67.4	59.2	63.2	62.3	59.0	57.4	62.2	56.8
ind can do little to change soc	32.5	37.1	31.1	30.8	29.6	34.0	33.0	33.2	32.0
marijuana should be legalized	15.8	18.7	18.1	15.4	15.4	19.6	13.7	19.7	18.7
married women best at home	20.6	23.1	20.2	14.3	17.3	16.1	13.3	13.0	14.5
national health care plan needed	48.0	42.7	49.2	50.0	51.8	50.5	50.0	56.1	54.9
raise taxes to reduce deficit	32.4	36.3	25.5	29.3	26.7	27.8	26.2	24.0	25.2
wealthy should pay more taxes	76.0	77.0	74.3	78.7	77.5	77.1	73.0	80.5	72.8
in 1989									
abolish death penalty	18.6	18.8	23.4	31.8	32.4	25.8	27.2	29.6	29.5
abortion should be legalized	69.6	68.1	70.0	72.5	70.7	74.1	70.3	74.5	76.8
busing OK to achieve balance	39.2	35.0	42.1	43.0	45.4	44.9	46.0	49.9	50.6
coll ban extreme speakers	18.7	19.7	17.2	15.3	15.2	12.9	14.1	12.4	11.8
coll involvement in social pgms	71.8	71.6	73.1	76.0	78.9	79.4	82.0	79.1	83.1
coll regulate off-campus acts	10.4	10.7	12.9	10.8	12.0	10.2	9.9	10.4	9.0
college raises earning power	47.3	47.3	45.5	35.2	36.6	37.2	33.5	36.0	39.4
control AIDS w/mandatory testing	33.7	32.8	33.4	26.8	26.5	31.1	27.9	27.9	28.6
equal opportunity for women	95.4	94.3	95.8	97.5	97.3	95.8	97.0	96.6	97.1
gov't not controlling pollution	86.0	84.6	87.3	90.7	89.0	88.6	94.7	96.0	91.6
gov't not promoting disarmament	49.0	48.7	50.9	65.2	63.0	64.2	71.1	75.2	72.0
grading in college too easy	32.2	33.6	30.7	39.2	34.5	33.4	28.9	37.1	30.2
ind can do little to change soc	35.5	37.0	31.7	34.5	30.0	29.3	31.6	29.1	26.8
man not entitled to sex on date	92.9	93.5	94.8	95.5	96.5	95.5	96.5	95.8	96.0
marijuana should be legalized	17.0	21.3	21.8	20.3	20.2	23.6	17.6	21.8	23.0
married women best at home	11.7	13.0	11.7	5.1	8.2	8.5	5.9	7.1	5.8
national health care plan needed	54.5	46.0	54.7	61.4	61.5	65.2	65.4	66.8	67.5
racial discrim no longer problem	16.7	20.6	15.2	10.5	12.3	10.4	8.8	9.8	8.2
raise taxes to reduce deficit	35.2	35.7	35.0	38.2	37.9	34.6	34.6	36.6	34.5
wealthy should pay more taxes	69.0	65.5	73.7	76.4	78.3	77.6	74.8	77.2	73.9

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Agrees Strongly or Somewhat									
a lot of racial conflict here	19.0	17.6	20.2	14.6	20.9	22.8	24.1	22.7	25.3
admin care little about students	34.9	36.4	34.3	30.2	28.4	28.5	30.3	31.4	25.8
admin considers faculty concerns	70.4	72.1	67.3	71.1	73.0	69.5	68.8	72.8	72.2
admin considers student concerns	42.7	48.1	43.3	47.8	47.9	51.2	48.2	53.7	49.2
courses incl feminist perspectve	27.6	29.3	37.5	44.7	43.6	42.1	48.5	45.6	48.8
courses incl minority perspectve	25.7	33.2	38.8	44.2	44.7	44.0	45.2	43.1	47.6
curriculum over-specialized	26.4	25.9	25.3	15.7	18.6	19.9	21.5	22.9	17.2
ethnic groups communicate well	66.8	67.8	71.1	76.6	73.4	69.5	69.8	69.8	68.0
fac committed to welfare of coll	71.2	68.3	70.6	77.5	76.5	73.3	77.4	72.7	78.1
fac feels students well-prepared	78.6	69.7	77.2	77.0	79.8	77.4	79.4	72.6	78.4
fac interested in acad problems	66.1	57.7	68.7	81.6	78.7	74.1	75.1	72.4	76.9
fac interested in student probs	48.1	39.7	57.1	67.1	68.2	60.7	67.7	64.3	67.2
fac positive about gen ed pgm	84.0	83.5	86.4	87.4	87.3	86.2	86.7	88.5	88.9
fac sensitive to minority issues	61.1	66.5	69.1	70.2	74.4	71.9	71.3	71.5	74.2
low trust btwn minorities/admin	27.6	32.0	24.9	25.6	25.5	27.8	29.2	33.1	29.4
many students don't "fit in"	30.8	33.0	28.9	24.8	27.4	31.7	33.5	28.8	31.3
oppty for fac/stdnt socializing	40.2	41.6	42.0	55.7	56.6	50.0	52.6	52.0	53.5
students resent required courses	56.2	58.0	52.3	53.4	51.9	52.5	51.7	53.2	47.0
Objectives Rated as High or Highest Priorities for College									
allow airing of diff opinions	35.3	30.8	39.0	51.0	44.9	48.4	49.8	46.8	50.2
conduct basic & applied research	63.8	71.9	53.3	48.3	44.6	49.0	55.9	57.0	52.1
create multi-cultural environ	29.2	30.4	31.0	35.4	40.3	38.9	42.8	38.7	45.1
create positive undergrad exp	61.3	51.9	60.6	69.7	70.2	69.4	71.1	67.0	74.5
devel apprec of multi-cultul soc	24.3	25.3	34.1	36.8	41.2	41.0	43.4	44.6	48.4
devel community among fac/stdnts	26.3	22.8	34.8	41.9	43.0	38.6	44.4	41.6	47.8
devel leadership ability in fac	32.4	32.3	36.2	29.3	32.6	32.8	34.4	37.8	35.0
devel leadership abil in stdnts	46.6	40.5	52.2	44.1	48.9	47.7	47.3	50.4	53.4
economize and cut costs	35.3	35.4	35.1	31.4	32.3	32.2	37.0	35.8	35.4
enhance inst's national image	80.9	81.3	76.9	71.3	70.2	71.0	71.6	74.6	73.0
facilitate comm svcs involvement	20.8	15.6	23.6	26.7	26.1	26.9	33.3	31.7	35.2
help solve soc/environ problems	20.2	16.7	22.9	19.8	25.5	26.2	30.6	30.1	30.5
help students understand values	35.7	27.7	47.9	49.1	55.6	49.3	51.1	54.1	60.1
hire faculty "stars"	26.8	30.3	25.3	20.9	21.3	22.9	24.5	24.7	24.4
increase minorities in fac/admin	23.7	21.6	23.8	20.9	27.9	23.6	25.5	25.9	29.0
increase women in fac/admin	16.4	14.6	20.0	24.7	24.2	23.7	24.5	20.5	29.1
increase/maintain inst prestige	83.4	82.9	82.6	79.4	82.7	80.4	79.2	82.6	83.2
promote intellectual development	79.0	76.5	80.8	84.4	83.3	81.8	84.6	84.6	85.5
raise money for the institution	68.5	70.7	60.6	68.0	65.2	65.9	70.7	71.1	67.1
recruit more minority students	37.4	32.6	37.4	36.4	39.5	35.6	37.7	38.9	39.2
teach students how to change soc	19.7	14.9	27.3	23.0	29.9	29.7	27.1	29.2	34.1
Want Copy of Survey Results									
no	8.3	10.3	7.1	9.4	6.0	8.5	9.4	5.9	6.4
yes	91.7	89.7	92.9	90.6	94.0	91.5	90.6	94.1	93.6

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
None									
classes/labs	0.4	0.4	0.5	0.0	0.3	0.0	0.0	0.3	0.6
studying/homework	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.3	0.1
socializing with friends	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.1
talk with faculty outside class	7.6	9.1	8.0	4.0	3.9	5.9	7.0	6.9	5.4
exercising/sports	4.5	6.8	5.2	5.3	4.5	6.5	5.6	3.4	3.8
reading for pleasure	29.8	28.7	23.4	21.5	23.6	24.5	27.8	27.5	19.9
using a personal computer	7.1	11.1	14.2	16.3	14.3	17.1	28.8	27.0	21.9
partying	12.8	19.8	12.7	20.3	16.0	15.2	15.7	15.4	13.6
working (for pay)	43.4	40.0	34.0	20.8	25.3	26.3	24.8	24.9	23.8
volunteer work	71.5	68.4	65.3	68.2	60.2	63.8	58.1	59.5	56.1
student clubs/groups	27.5	31.7	34.8	36.7	32.1	32.7	25.2	34.6	28.8
watching TV	11.1	15.6	9.5	12.6	13.3	10.7	10.2	11.2	13.4
commuting to campus	51.3	43.9	45.9	58.3	56.2	48.7	46.9	43.0	47.6
religious services/meetings	50.5	54.0	47.7	50.9	49.7	54.0	47.6	53.6	49.4
hobbies	26.3	27.8	23.8	27.9	24.4	25.1	24.4	25.7	24.1
Six or More									
classes/labs	93.1	96.6	92.7	94.9	94.3	95.5	94.7	95.8	93.6
studying/homework	91.8	91.3	81.2	86.3	86.6	82.9	86.8	86.7	84.1
socializing with friends	78.8	70.2	77.5	80.8	79.6	77.7	76.1	77.4	78.4
talk with faculty outside class	2.4	1.1	3.2	5.5	4.8	2.8	4.7	4.2	4.9
exercising/sports	34.1	31.7	37.6	27.6	32.8	32.1	29.9	31.5	29.1
reading for pleasure	5.4	5.3	8.4	8.8	7.8	6.9	5.0	4.2	5.8
using a personal computer	31.1	26.7	25.0	27.9	28.7	23.8	10.3	9.1	21.7
partying	27.0	25.1	28.6	22.0	24.6	29.1	23.3	25.8	29.1
working (for pay)	42.7	46.4	56.8	62.1	58.5	60.2	59.6	63.0	62.8
volunteer work	1.3	2.7	3.2	1.9	2.3	3.2	4.9	6.9	6.5
student clubs/groups	11.2	11.5	11.8	9.6	10.5	13.0	11.6	11.7	14.8
watching TV	29.0	23.2	30.5	28.2	26.2	28.6	24.9	29.0	27.2
commuting to campus	6.1	10.3	7.3	5.1	7.5	9.6	5.5	8.0	7.6
religious services/meetings	2.3	0.8	2.8	1.7	2.3	1.7	1.9	1.6	2.3
hobbies	6.2	6.5	12.0	10.6	9.9	7.4	6.4	6.3	7.4
Sixteen or More									
classes/labs	64.5	61.0	52.1	48.8	56.9	45.3	65.2	67.5	48.2
studying/homework	54.4	58.5	37.9	43.6	44.1	38.4	38.6	37.9	34.1
socializing with friends	28.9	21.8	32.6	33.5	31.6	35.3	27.3	27.4	30.4
talk with faculty outside class	0.2	0.4	0.1	0.4	0.3	0.2	0.4	0.3	0.4
exercising/sports	5.6	4.5	7.7	5.7	7.9	7.2	5.8	5.3	5.3
reading for pleasure	0.1	0.4	1.1	1.7	0.8	1.0	0.4	0.3	0.4
using a personal computer	6.8	3.8	6.9	8.7	10.2	6.4	1.1	1.1	4.1
partying	3.2	1.5	7.4	4.7	5.0	8.0	4.6	4.3	6.0
working (for pay)	16.9	22.3	30.7	22.9	24.5	29.5	22.9	22.2	27.2
volunteer work	0.2	0.0	0.7	0.4	1.0	0.5	0.6	2.6	1.8
student clubs/groups	2.4	2.3	1.7	1.5	1.8	3.2	1.6	3.5	2.9
watching TV	4.8	3.4	5.3	5.1	4.0	5.9	3.4	4.3	4.4
commuting to campus	0.3	0.0	0.7	0.2	0.6	0.8	0.1	1.1	0.4
religious services/meetings	0.3	0.0	0.1	0.4	0.2	0.2	0.1	0.3	0.3
hobbies	1.3	1.9	1.6	1.5	1.6	1.5	0.7	1.1	1.7

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Religious Preference in 1985									
Baptist	8.2	7.8	10.6	6.7	9.9	9.3	8.4	8.4	9.1
Buddhist	0.8	0.0	0.1	0.4	0.2	0.2	0.6	0.3	0.7
Congregational (U.C.C.)	1.7	0.9	1.8	2.4	2.4	2.6	2.2	3.6	2.3
Eastern Orthodox	0.1	0.4	0.8	0.6	0.7	0.5	1.1	0.8	0.6
Episcopal	2.5	3.0	2.2	2.8	2.0	2.9	3.5	3.1	3.2
Islamic	0.1	0.4	0.0	0.0	0.0	0.5	0.5	0.3	0.3
Jewish	2.4	3.5	1.9	3.5	2.4	3.3	4.9	5.9	4.1
Latter Day Saints (Mormon)	0.3	0.9	0.7	0.4	0.0	0.5	0.1	0.0	0.1
Lutheran	8.5	6.1	6.2	5.0	5.1	7.0	4.6	5.9	6.6
Methodist	7.3	9.1	7.9	8.6	10.2	12.9	9.2	11.2	9.5
Presbyterian	5.8	4.3	5.6	4.8	6.8	6.2	6.6	5.0	6.4
Quaker (Society of Friends)	0.2	0.4	0.0	0.4	0.2	0.3	0.1	1.1	0.5
Roman Catholic	41.0	38.1	41.6	36.9	34.1	32.6	34.6	32.5	37.3
Seventh Day Adventist	0.2	0.0	0.3	0.2	0.2	0.0	0.5	0.6	0.6
other Protestant	4.0	7.8	6.2	8.2	7.3	4.6	7.6	5.3	6.3
other religion	4.2	3.0	4.1	3.7	3.9	4.6	4.9	3.6	4.0
none	12.7	14.3	10.1	15.3	14.7	11.9	10.5	12.3	8.7
in 1989									
Baptist	8.0	6.7	10.2	6.5	10.3	9.3	6.9	6.9	8.1
Buddhist	1.0	0.0	0.4	1.1	0.3	0.7	0.7	0.3	0.5
Congregational (UCC)	1.4	0.7	1.7	1.3	2.1	2.5	1.6	2.1	2.7
Eastern Orthodox	0.3	0.4	0.9	0.6	0.8	0.7	1.4	0.5	0.5
Episcopal	2.6	3.0	1.9	2.3	1.9	3.0	3.2	3.2	3.1
Islamic	0.0	1.1	0.0	0.2	0.0	0.3	0.5	0.3	0.5
Jewish	2.1	3.0	1.9	2.9	2.4	3.2	4.8	4.8	4.8
Latter Day Saints (Mormon)	0.2	0.4	0.7	0.2	0.0	0.3	0.1	0.3	0.1
Lutheran	7.4	4.9	6.1	4.0	4.7	5.3	4.0	5.8	5.5
Methodist	5.6	9.7	6.3	7.6	8.4	9.3	7.9	8.7	7.6
Presbyterian	6.0	4.1	4.5	4.4	5.0	5.5	6.1	4.8	5.6
Quaker	0.2	0.0	0.1	0.6	0.5	0.7	0.4	1.1	0.7
Roman Catholic	37.6	34.7	39.2	32.4	31.7	29.7	31.6	31.2	33.5
Seventh Day Adventist	0.1	0.0	0.0	0.0	0.2	0.0	0.2	0.3	0.5
other Protestant	5.2	7.1	6.5	8.2	6.8	6.5	8.8	7.7	6.3
other religion	3.3	3.7	3.2	4.2	3.2	4.2	5.0	3.7	4.0
none	19.0	20.5	16.5	23.5	21.7	18.8	16.8	18.5	16.0
Born-again Christian in 1985									
no	84.1	84.1	80.1	84.6	75.7	79.4	79.1	80.7	79.1
yes	15.9	15.9	19.9	15.4	24.3	20.6	20.9	19.3	20.9
in 1989									
no	84.5	82.6	80.9	85.1	79.6	81.9	80.4	83.3	81.9
yes	15.5	17.4	19.1	14.9	20.4	18.1	19.6	16.7	18.1

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Career in 1985 (7)									
artist (including performer)	0.2	2.6	1.2	0.4	1.5	1.0	0.3	2.2	0.8
business	2.6	9.0	2.7	4.3	7.8	6.3	1.5	7.5	1.5
clergy or religious worker	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.1
college teacher	0.0	0.4	0.0	1.9	0.5	1.4	0.1	0.8	0.2
doctor (MD or DDS)	1.9	8.1	0.8	6.2	15.0	8.5	52.4	15.2	53.7
education (secondary)	0.1	0.4	0.0	7.1	5.2	6.5	1.8	1.7	1.2
education (primary)	0.0	0.0	0.0	0.0	1.2	0.5	0.0	1.4	0.2
engineer	85.7	31.6	77.7	3.4	24.0	6.6	0.1	9.4	0.4
farmer or forester	0.1	1.3	0.0	0.0	0.5	0.3	3.9	1.1	3.0
health professional (non-M.D.)	0.1	0.9	0.4	1.7	3.2	2.2	15.5	12.2	14.3
lawyer	0.4	3.0	0.3	0.6	2.0	1.7	0.3	1.7	1.2
nurse	0.0	0.0	0.0	0.0	0.7	0.2	0.1	3.3	0.5
research scientist	1.0	7.3	1.4	27.8	4.2	12.1	11.3	6.1	8.1
other choice	6.6	22.6	11.5	33.0	19.3	38.0	5.8	14.9	5.2
undecided	1.3	12.8	3.8	13.5	15.1	14.6	6.9	22.7	9.6
Probable Career in 1989 (7)									
artist (including performer)	0.1	0.0	3.7	1.3	0.5	2.5	0.2	0.8	3.6
business	5.5	6.8	28.0	8.4	9.3	25.9	5.2	5.6	20.1
clergy or religious worker	0.0	0.0	0.3	0.4	0.0	0.5	0.5	0.8	0.8
college teacher	0.9	0.8	2.8	8.2	4.2	5.6	1.4	1.6	3.9
doctor (MD or DDS)	1.2	3.0	2.1	2.3	8.0	3.7	38.5	24.4	13.8
education (secondary)	0.1	0.8	4.5	9.3	8.9	7.9	4.1	4.2	6.2
education (primary)	0.0	0.0	1.1	0.4	1.1	4.7	0.4	1.1	5.3
engineer	75.4	70.3	8.1	3.2	4.6	7.2	0.0	0.3	1.7
farmer or forester	0.0	0.4	0.5	0.2	1.1	1.2	4.1	5.3	1.7
health professional (non-M.D.)	0.2	0.0	1.5	1.3	2.8	2.5	15.5	19.4	3.9
lawyer	1.2	2.6	3.3	0.6	1.1	5.2	1.0	1.6	8.1
nurse	0.0	0.0	0.0	0.0	0.0	0.7	0.9	0.8	1.9
research scientist	1.3	2.6	6.7	24.5	18.5	3.5	16.6	15.6	5.0
other choice	12.9	12.4	33.9	34.6	34.0	24.6	8.3	11.9	19.2
undecided	1.2	0.4	3.5	5.3	5.9	4.2	3.2	6.6	4.8
Reasons Noted as Very Important or Essential for Choosing Career									
job opportunities available	71.1	64.0	58.7	54.6	57.6	56.6	53.2	54.1	53.6
enjoy working w/people in field	55.4	52.6	66.8	62.8	65.1	68.3	77.0	74.9	76.2
work is interesting	94.5	95.5	94.7	94.8	95.0	93.7	97.2	95.7	95.4
pays well	62.6	60.4	52.4	43.8	48.3	49.1	44.5	42.2	48.5
satisfies parents' hopes	13.9	13.4	9.4	7.8	9.0	9.8	10.6	12.0	12.4
work is challenging	86.0	83.5	85.0	82.8	84.2	85.2	87.7	84.7	86.1
can make contribution to society	51.0	53.7	55.7	50.8	59.7	60.1	81.7	78.7	71.3
oppty for rapid career advancmnt	48.9	42.9	51.1	31.2	40.1	42.3	30.0	32.3	39.4
oppty for freedom of action	48.8	50.6	56.4	59.2	56.8	59.7	60.7	60.7	63.6

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Major in 1985 (7)									
agriculture	0.0	1.2	0.0	0.0	0.2	0.0	5.8	0.0	3.8
biological sciences	0.0	5.8	0.0	0.0	7.9	0.0	53.6	0.0	47.4
business	0.0	6.4	0.0	0.0	8.1	0.0	0.0	10.0	0.0
education	0.0	1.2	0.0	0.0	7.1	0.0	0.0	3.1	0.0
engineering	100.0	0.0	100.0	0.0	30.8	0.0	0.0	11.8	0.0
English	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.9	0.0
health professional	0.0	7.0	0.0	0.0	14.3	0.0	40.6	11.2	48.8
history or political science	0.0	1.7	0.0	0.0	2.1	0.0	0.0	0.9	0.0
humanities	0.0	0.6	0.0	0.0	1.5	0.0	0.0	1.6	0.0
fine arts	0.0	7.0	0.0	0.0	0.9	0.0	0.0	2.8	0.0
mathematics or statistics	0.0	6.4	0.0	30.3	0.0	23.7	0.0	2.5	0.0
physical sciences	0.0	19.8	0.0	48.1	0.0	42.9	0.0	9.3	0.0
social sciences	0.0	1.7	0.0	0.0	1.9	0.0	0.0	6.2	0.0
other technical	0.0	21.5	0.0	21.5	12.0	33.4	0.0	13.4	0.0
other non-technical	0.0	5.8	0.0	0.0	2.1	0.0	0.0	7.8	0.0
undecided	0.0	14.0	0.0	0.0	11.0	0.0	0.0	18.4	0.0
Major Reported in 1989 (7)									
agriculture	0.0	0.0	0.8	0.0	0.0	0.4	6.0	7.4	0.0
biological sciences	0.0	0.0	4.8	0.0	0.0	7.4	82.0	84.7	0.0
business	0.0	0.0	23.5	0.0	0.0	19.2	0.0	0.0	12.8
education	0.0	0.0	3.2	0.0	0.0	8.7	0.0	0.0	9.1
engineering	100.0	100.0	0.0	0.0	0.0	12.0	0.0	0.0	2.5
English	0.0	0.0	3.3	0.0	0.0	5.6	0.0	0.0	5.8
health professional	0.0	0.0	0.9	0.0	0.0	2.5	11.9	7.9	2.5
history or political science	0.0	0.0	7.1	0.0	0.0	8.3	0.0	0.0	9.8
humanities	0.0	0.0	3.3	0.0	0.0	5.2	0.0	0.0	5.5
fine arts	0.0	0.0	3.0	0.0	0.0	1.2	0.0	0.0	3.6
mathematics or statistics	0.0	0.0	6.8	32.8	30.8	0.0	0.0	0.0	1.8
physical sciences	0.0	0.0	13.3	44.1	47.0	0.0	0.0	0.0	11.0
social sciences	0.0	0.0	13.9	0.0	0.0	16.9	0.0	0.0	28.1
other technical	0.0	0.0	11.3	23.0	22.2	8.1	0.0	0.0	2.5
other non-technical	0.0	0.0	4.8	0.0	0.0	4.3	0.0	0.0	4.9
undecided	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.2
Probable Graduate Major (7)									
agriculture	0.0	0.6	0.0	0.0	0.2	0.0	1.6	1.8	0.4
biological sciences	0.8	1.1	4.1	3.5	3.2	6.1	29.1	28.5	2.8
business	27.8	21.1	35.6	10.5	14.9	25.7	4.0	4.3	19.0
education	0.8	1.7	4.3	6.5	7.4	10.3	2.9	5.0	10.4
engineering	55.3	51.7	9.8	5.9	7.7	6.1	0.8	0.0	1.5
English	0.2	0.0	1.8	0.3	0.2	2.4	0.0	0.0	1.5
health professional	1.6	1.7	2.9	1.6	6.8	4.6	30.4	30.2	10.9
history or political science	0.6	1.1	5.5	0.8	1.1	3.9	0.3	1.4	1.9
humanities	0.0	0.6	2.4	1.1	1.1	3.4	0.3	0.4	2.2
fine arts	0.2	0.6	1.6	0.5	1.3	1.5	0.0	0.4	2.7
mathematics or statistics	0.2	1.7	1.4	14.6	8.9	1.5	0.0	0.0	0.8
physical sciences	0.8	2.8	8.1	32.9	24.0	2.0	0.8	1.1	5.1
social sciences	0.0	0.6	4.5	1.1	1.1	9.3	1.6	2.5	14.5
other technical	5.0	5.6	5.3	15.1	14.0	8.1	16.0	11.7	5.9
other non-technical	4.7	7.2	9.4	3.2	3.6	11.7	10.0	8.2	17.2
undecided	2.3	2.2	3.3	2.4	4.5	3.4	2.1	4.6	3.3

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
DISAGGREGATED RESPONSES									
Probable Career in 1985									
accountant or actuary	0.0	1.3	0.1	1.3	2.0	1.0	0.1	1.9	0.0
actor or entertainer	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1
architect or urban planner	0.2	3.0	0.3	0.0	0.2	0.0	0.0	0.3	0.1
artist	0.0	0.4	0.3	0.0	0.5	0.0	0.0	0.6	0.1
business (clerical)	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.0	0.0
business executive (mgmt,admin)	2.2	4.3	1.9	2.1	5.0	4.6	1.1	4.7	1.2
business owner or proprietor	0.4	3.0	0.5	0.6	0.8	0.3	0.1	0.8	0.3
business salesperson or buyer	0.0	0.4	0.1	0.2	0.0	0.3	0.1	0.0	0.0
clergy (minister,priest)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
clergy (other religious)	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0
clinical psychologist	0.0	0.4	0.1	0.2	1.2	0.0	0.1	0.6	0.2
college teacher	0.0	0.4	0.0	1.9	0.5	1.4	0.1	0.8	0.2
computer programmer or analyst	0.8	9.8	1.8	20.8	11.3	27.2	0.0	4.1	0.0
conservationist or forester	0.0	0.9	0.0	0.0	0.5	0.3	2.1	0.8	2.1
dentist (including orthodontist)	0.0	0.4	0.3	0.4	1.0	0.7	2.5	1.7	3.3
dietitian or home economist	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
engineer	85.7	31.6	77.7	3.4	24.0	6.6	0.1	9.4	0.4
farmer or rancher	0.1	0.4	0.0	0.0	0.0	0.0	1.8	0.3	0.9
frgn svc worker (incl diplomat)	0.0	0.0	0.0	0.2	0.7	0.3	0.1	0.8	0.2
homemaker (full-time)	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
interior decorator or designer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
interpreter (translator)	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.1
lab technician or hygienist	0.0	0.0	0.1	0.4	0.5	0.5	2.3	3.3	1.6
law enforcement officer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
lawyer (attorney) or judge	0.4	3.0	0.3	0.6	2.0	1.7	0.3	1.7	1.2
military service (career)	4.6	4.3	7.2	2.4	3.5	2.2	0.3	1.4	0.4
musician (performer,composer)	0.2	1.7	0.8	0.2	0.3	0.5	0.0	0.6	0.1
nurse	0.0	0.0	0.0	0.0	0.7	0.2	0.1	3.3	0.5
optometrist	0.0	0.0	0.0	0.9	0.7	0.3	0.9	1.4	1.2
pharmacist	0.0	0.4	0.1	0.4	0.5	0.7	3.7	0.6	4.2
physician	1.9	7.7	0.5	5.8	14.0	7.8	49.9	13.5	50.5
school counselor	0.0	0.0	0.0	0.0	0.2	0.2	0.5	0.0	0.0
school principal/superintendent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
scientific researcher	1.0	7.3	1.4	27.8	4.2	12.1	11.3	6.1	8.1
social,welfare or rec worker	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.8	0.0
statistician	0.0	0.0	0.0	2.4	0.2	1.4	0.0	0.0	0.0
therapist (phys,occup,speech)	0.0	0.0	0.0	0.0	0.5	0.3	0.5	6.4	1.0
teacher/admin (elementary)	0.0	0.0	0.0	0.0	1.2	0.5	0.0	1.4	0.2
teacher/admin (secondary)	0.1	0.4	0.0	7.1	5.0	6.3	1.3	1.7	1.2
veterinarian	0.0	0.4	0.1	0.0	1.0	0.2	8.2	0.6	6.3
writer or journalist	0.0	0.4	0.1	0.2	0.7	0.3	0.3	0.8	0.6
skilled trades	0.0	1.7	0.3	0.2	0.0	0.0	0.3	0.0	0.1
other	0.9	3.4	1.6	6.9	1.8	6.5	4.7	6.9	4.1
undecided	1.3	12.8	3.8	13.5	15.1	14.6	6.9	22.7	9.6

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Career in 1989									
accountant or actuary	0.0	0.0	6.5	4.9	4.1	6.6	0.1	0.8	2.9
actor or entertainer	0.0	0.0	0.7	0.2	0.0	0.2	0.1	0.3	0.3
architect or urban planner	0.0	0.8	0.9	0.2	0.3	0.2	0.0	0.5	1.0
artist	0.0	0.0	0.9	0.0	0.0	0.2	0.0	0.0	0.8
business (clerical)	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.3
business executive (mgmt,admin)	3.6	4.9	15.2	3.0	3.7	15.0	3.5	2.9	13.5
business owner or proprietor	1.5	1.5	3.5	0.6	0.8	2.2	0.7	1.1	1.7
business salesperson or buyer	0.4	0.4	2.8	0.0	0.7	2.2	0.9	0.8	2.0
clergy (minister,priest)	0.0	0.0	0.1	0.4	0.0	0.3	0.2	0.8	0.3
clergy (other religious)	0.0	0.0	0.1	0.0	0.0	0.2	0.2	0.0	0.6
clinical psychologist	0.0	0.0	0.5	0.0	0.0	0.8	0.4	0.0	3.6
college teacher	0.9	0.8	2.8	8.2	4.2	5.6	1.4	1.6	3.9
computer programmer or analyst	2.8	3.0	9.3	22.8	20.7	10.1	0.4	0.5	1.3
conservationist or forester	0.0	0.4	0.5	0.2	1.1	1.2	3.2	4.2	1.0
dentist (including orthodontist)	0.0	0.0	0.4	0.2	0.5	0.5	3.7	2.4	1.3
dietitian or home economist	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.2
engineer	75.4	70.3	8.1	3.2	4.6	7.2	0.0	0.3	1.7
farmer or rancher	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.1	0.6
frgn svc worker (incl diplomat)	0.0	0.0	0.7	0.0	0.0	0.5	0.0	0.3	1.2
homemaker (full-time)	0.0	0.4	0.0	0.4	0.0	0.0	0.1	0.0	0.0
interior decorator or designer	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.3
interpreter (translator)	0.0	0.4	0.1	0.0	0.0	0.3	0.0	0.0	0.0
lab technician or hygienist	0.0	0.0	0.5	0.6	0.8	0.5	3.7	4.5	0.9
law enforcement officer	0.0	0.4	1.1	0.0	0.0	1.0	0.4	0.5	0.6
lawyer (attorney) or judge	1.2	2.6	3.3	0.6	1.1	5.2	1.0	1.6	8.1
military service (career)	8.5	4.9	12.9	4.0	6.5	2.2	0.9	0.8	0.5
musician (performer,composer)	0.1	0.0	0.5	0.4	0.2	0.0	0.0	0.3	0.5
nurse	0.0	0.0	0.0	0.0	0.0	0.7	0.9	0.8	1.9
optometrist	0.0	0.0	0.0	0.0	0.2	0.3	1.7	1.9	0.4
pharmacist	0.0	0.0	0.0	0.2	0.8	0.3	4.6	5.6	0.3
physician	1.2	3.0	1.7	2.1	7.5	3.2	34.8	22.0	12.5
school counselor	0.0	0.0	0.4	0.2	0.0	0.8	0.1	0.3	0.9
school principal/superintendent	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0
scientific researcher	1.3	2.6	6.7	24.5	18.5	3.5	16.6	15.6	5.0
social,welfare or rec worker	0.0	0.0	0.3	0.0	0.0	1.0	0.1	0.5	2.4
statistician	0.0	0.0	0.7	2.5	2.0	0.3	0.0	0.0	0.0
therapist (phys,occup,speech)	0.1	0.0	0.8	0.0	0.5	1.0	2.2	6.1	1.7
teacher/admin (elementary)	0.0	0.0	1.1	0.4	1.1	4.7	0.4	1.1	5.3
teacher/admin (secondary)	0.1	0.8	4.1	8.9	8.8	7.1	4.0	4.0	5.2
veterinarian	0.1	0.0	0.1	0.2	0.3	0.2	3.2	1.3	0.5
writer or journalist	0.0	0.0	1.5	0.6	0.3	2.0	0.1	0.3	1.7
skilled trades	0.0	0.0	0.4	0.2	0.0	0.2	0.2	0.0	0.4
other	1.6	2.6	6.8	4.4	4.4	7.9	5.8	8.8	8.1
undecided	1.2	0.4	3.5	5.3	5.9	4.2	3.2	6.6	4.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Major Reported in 1985									
Arts and Humanities									
art, fine & applied	0.0	1.7	0.0	0.0	0.3	0.0	0.0	0.9	0.0
English (language & literature)	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.9	0.0
history	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0
journalism	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.6	0.0
language (except English)	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.3	0.0
music	0.0	1.2	0.0	0.0	0.3	0.0	0.0	0.9	0.0
philosophy	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.6	0.0
speech	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
theater or drama	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
theology or religion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other arts and humanities	0.0	0.6	0.0	0.0	0.2	0.0	0.0	0.6	0.0
Biological Sciences									
biology (general)	0.0	2.3	0.0	0.0	4.0	0.0	28.9	0.0	29.1
biochemistry or biophysics	0.0	1.2	0.0	0.0	2.2	0.0	10.2	0.0	7.1
botany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
marine (life) science	0.0	0.6	0.0	0.0	0.3	0.0	2.8	0.0	2.2
microbiology or bacteriology	0.0	0.6	0.0	0.0	0.2	0.0	3.6	0.0	1.6
zoology	0.0	0.0	0.0	0.0	0.2	0.0	1.6	0.0	2.5
other biological sciences	0.0	1.2	0.0	0.0	1.0	0.0	6.4	0.0	4.8
Business									
accounting	0.0	0.0	0.0	0.0	2.1	0.0	0.0	3.4	0.0
business admin (general)	0.0	1.2	0.0	0.0	2.2	0.0	0.0	3.1	0.0
finance	0.0	0.6	0.0	0.0	1.2	0.0	0.0	1.2	0.0
marketing	0.0	1.2	0.0	0.0	0.7	0.0	0.0	0.6	0.0
management	0.0	2.3	0.0	0.0	1.0	0.0	0.0	0.6	0.0
secretarial studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other business	0.0	1.2	0.0	0.0	0.9	0.0	0.0	0.9	0.0
Education									
business education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
elementary education	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.9	0.0
music or art education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
physical education or recreation	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
secondary education	0.0	1.2	0.0	0.0	5.2	0.0	0.0	1.9	0.0
special education	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0
other education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engineering									
aeronautical/astronautical eng	12.0	0.0	17.5	0.0	5.2	0.0	0.0	1.6	0.0
civil engineering	6.0	0.0	7.1	0.0	1.7	0.0	0.0	0.3	0.0
chemical engineering	8.8	0.0	7.5	0.0	2.9	0.0	0.0	1.2	0.0
electrical/electronic eng	38.4	0.0	31.7	0.0	11.5	0.0	0.0	2.8	0.0
industrial engineering	3.3	0.0	4.5	0.0	1.0	0.0	0.0	0.3	0.0
mechanical engineering	18.5	0.0	13.1	0.0	3.6	0.0	0.0	0.9	0.0
other engineering	13.0	0.0	18.6	0.0	4.8	0.0	0.0	4.7	0.0

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Major Reported in 1985									
Physical Sciences									
astronomy	0.0	0.6	0.0	2.1	0.0	2.3	0.0	0.0	0.0
atmospheric science	0.0	0.0	0.0	1.3	0.0	1.7	0.0	0.3	0.0
chemistry	0.0	4.1	0.0	20.7	0.0	20.2	0.0	5.6	0.0
earth science	0.0	1.2	0.0	2.1	0.0	2.3	0.0	0.0	0.0
marine science	0.0	0.0	0.0	1.7	0.0	3.5	0.0	1.9	0.0
mathematics	0.0	5.8	0.0	29.3	0.0	22.7	0.0	2.2	0.0
physics	0.0	13.4	0.0	19.7	0.0	11.1	0.0	0.6	0.0
statistics	0.0	0.6	0.0	1.0	0.0	1.0	0.0	0.3	0.0
other physical sciences	0.0	0.6	0.0	0.6	0.0	1.8	0.0	0.9	0.0
Professional									
architecture/urban planning	0.0	3.5	0.0	0.0	0.2	0.0	0.0	0.9	0.0
home economics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
health technology	0.0	0.6	0.0	0.0	1.4	0.0	0.0	8.7	0.0
library or archival science	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nursing	0.0	0.0	0.0	0.0	0.9	0.0	0.0	4.0	0.0
pharmacy	0.0	0.6	0.0	0.0	0.3	0.0	3.7	0.0	4.2
predent,premed,prevet	0.0	5.8	0.0	0.0	12.6	0.0	36.9	0.0	44.6
therapy (phys,occupat,etc)	0.0	0.6	0.0	0.0	0.5	0.0	0.0	7.2	0.0
other professional	0.0	0.6	0.0	0.0	0.3	0.0	0.0	5.0	0.0
Social Sciences									
anthropology	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0
economics	0.0	1.2	0.0	0.0	0.2	0.0	0.0	0.6	0.0
ethnic studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
geography	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
political science	0.0	1.7	0.0	0.0	0.7	0.0	0.0	0.9	0.0
psychology	0.0	0.6	0.0	0.0	1.4	0.0	0.0	4.0	0.0
social work	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
sociology	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0
women's studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other social sciences	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Technical									
building trades	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
data processing,computer prog	0.0	4.7	0.0	0.0	9.6	0.0	0.0	1.6	0.0
drafting or design	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0
electronics	0.0	1.2	0.0	0.0	0.7	0.0	0.0	0.0	0.0
mechanics	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other technical	0.0	0.0	0.0	0.0	0.3	0.0	0.0	1.2	0.0
Other Fields									
agriculture	0.0	0.0	0.0	0.0	0.2	0.0	5.2	0.0	2.3
communications	0.0	1.7	0.0	0.0	0.3	0.0	0.0	0.9	0.0
computer science	0.0	9.9	0.0	21.5	0.0	33.4	0.0	1.6	0.0
forestry	0.0	1.2	0.0	0.0	0.0	0.0	0.6	0.0	1.5
law enforcement	0.0	0.6	0.0	0.0	0.2	0.0	0.0	0.0	0.0
military science	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other field	0.0	0.6	0.0	0.0	1.0	0.0	0.0	1.2	0.0
undecided	0.0	14.0	0.0	0.0	11.0	0.0	0.0	18.4	0.0

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
ITEM	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Major Reported in 1989									
Arts and Humanities									
art, fine & applied	0.0	0.0	1.8	0.0	0.0	0.4	0.0	0.0	2.0
English (language & literature)	0.0	0.0	3.3	0.0	0.0	5.6	0.0	0.0	5.8
history	0.0	0.0	2.3	0.0	0.0	3.7	0.0	0.0	3.7
journalism	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0	0.9
language (except English)	0.0	0.0	1.1	0.0	0.0	1.7	0.0	0.0	2.6
music	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.6
philosophy	0.0	0.0	0.8	0.0	0.0	1.2	0.0	0.0	1.4
speech	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.5
theater or drama	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2
theology or religion	0.0	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.5
other arts and humanities	0.0	0.0	1.2	0.0	0.0	1.4	0.0	0.0	0.9
Biological Sciences									
biology (general)	0.0	0.0	2.3	0.0	0.0	5.2	61.7	58.4	0.0
biochemistry or biophysics	0.0	0.0	1.1	0.0	0.0	0.6	6.9	6.3	0.0
botany	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
marine (life) science	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.5	0.0
microbiology or bacteriology	0.0	0.0	0.6	0.0	0.0	0.0	2.2	4.7	0.0
zoology	0.0	0.0	0.2	0.0	0.0	0.0	1.0	1.8	0.0
other biological sciences	0.0	0.0	0.8	0.0	0.0	1.6	9.4	12.6	0.0
Business									
accounting	0.0	0.0	5.9	0.0	0.0	4.8	0.0	0.0	2.2
business admin (general)	0.0	0.0	2.9	0.0	0.0	3.3	0.0	0.0	2.9
finance	0.0	0.0	5.0	0.0	0.0	2.7	0.0	0.0	1.1
marketing	0.0	0.0	3.2	0.0	0.0	2.9	0.0	0.0	2.6
management	0.0	0.0	4.8	0.0	0.0	3.3	0.0	0.0	3.1
secretarial studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other business	0.0	0.0	1.8	0.0	0.0	2.1	0.0	0.0	1.0
Education									
business education	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
elementary education	0.0	0.0	0.8	0.0	0.0	3.7	0.0	0.0	4.4
music or art education	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2
physical education or recreation	0.0	0.0	0.5	0.0	0.0	0.8	0.0	0.0	1.0
secondary education	0.0	0.0	1.4	0.0	0.0	3.9	0.0	0.0	2.5
special education	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.4
other education	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.6
Engineering									
aeronautical/astronautical eng	5.9	6.3	0.0	0.0	0.0	0.8	0.0	0.0	0.1
civil engineering	8.2	11.9	0.0	0.0	0.0	1.0	0.0	0.0	0.1
chemical engineering	7.1	4.5	0.0	0.0	0.0	0.4	0.0	0.0	0.3
electrical/electronic eng	33.0	25.0	0.0	0.0	0.0	3.3	0.0	0.0	0.4
industrial engineering	6.3	11.9	0.0	0.0	0.0	0.2	0.0	0.0	0.0
mechanical engineering	25.9	21.6	0.0	0.0	0.0	3.1	0.0	0.0	0.7
other engineering	13.6	18.7	0.0	0.0	0.0	3.3	0.0	0.0	0.7

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Major Reported in 1989									
Physical Sciences									
astronomy	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
atmospheric science	0.0	0.0	0.0	1.3	0.2	0.0	0.0	0.0	0.0
chemistry	0.0	0.0	3.6	18.0	25.7	0.0	0.0	0.0	9.7
earth science	0.0	0.0	1.1	3.8	5.8	0.0	0.0	0.0	0.5
marine science	0.0	0.0	0.8	0.6	1.1	0.0	0.0	0.0	0.1
mathematics	0.0	0.0	6.3	31.8	29.7	0.0	0.0	0.0	1.8
physics	0.0	0.0	6.5	19.0	10.9	0.0	0.0	0.0	0.2
statistics	0.0	0.0	0.5	1.0	1.1	0.0	0.0	0.0	0.0
other physical sciences	0.0	0.0	1.4	1.0	3.4	0.0	0.0	0.0	0.4
Professional									
architecture/urban planning	0.0	0.0	0.8	0.0	0.0	0.2	0.0	0.0	0.4
home economics	0.0	0.0	0.2	0.0	0.0	0.6	0.0	0.0	0.1
health technology	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	1.3
law	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
library or archival science	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nursing	0.0	0.0	0.2	0.0	0.0	0.8	0.0	0.0	1.7
pharmacy	0.0	0.0	0.0	0.0	0.0	0.2	3.7	3.9	0.0
predent,premed,prevet	0.0	0.0	0.2	0.0	0.0	0.4	8.3	3.9	0.0
therapy (phys,occupat,etc)	0.0	0.0	0.6	0.0	0.0	1.2	0.0	0.0	0.7
other professional	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.9
Social Sciences									
anthropology	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0	1.2
economics	0.0	0.0	7.4	0.0	0.0	6.6	0.0	0.0	6.7
ethnic studies	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1
geography	0.0	0.0	0.6	0.0	0.0	0.6	0.0	0.0	0.4
political science	0.0	0.0	4.8	0.0	0.0	4.7	0.0	0.0	6.1
psychology	0.0	0.0	4.1	0.0	0.0	6.0	0.0	0.0	14.8
social work	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.6
sociology	0.0	0.0	0.3	0.0	0.0	2.3	0.0	0.0	2.6
women's studies	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
other social sciences	0.0	0.0	0.9	0.0	0.0	0.6	0.0	0.0	1.6
Technical									
building trades	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
data processing,computer prog	0.0	0.0	2.9	0.0	0.0	7.6	0.0	0.0	0.6
drafting or design	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
electronics	0.0	0.0	0.5	0.0	0.0	0.4	0.0	0.0	0.1
mechanics	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
other technical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Other Fields									
agriculture	0.0	0.0	0.6	0.0	0.0	0.4	5.7	6.3	0.0
communications	0.0	0.0	1.7	0.0	0.0	0.8	0.0	0.0	1.3
computer science	0.0	0.0	6.9	23.0	22.2	0.0	0.0	0.0	0.2
forestry	0.0	0.0	0.2	0.0	0.0	0.0	0.4	1.1	0.0
law enforcement	0.0	0.0	0.5	0.0	0.0	0.6	0.0	0.0	0.3
military science	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
other field	0.0	0.0	1.5	0.0	0.0	1.9	0.0	0.0	1.5
undecided	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.2

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Graduate Major									
Arts and Humanities									
art, fine & applied	0.0	0.0	0.0	0.0	0.6	0.5	0.0	0.0	1.7
English (language & literature)	0.2	0.0	1.8	0.3	0.2	2.4	0.0	0.0	1.5
history	0.2	0.0	1.2	0.0	0.4	2.0	0.0	0.7	0.4
journalism	0.0	0.0	0.4	0.3	0.0	0.2	0.0	0.0	0.4
language (except English)	0.0	0.6	0.4	0.3	0.4	1.2	0.0	0.0	0.5
music	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.3
philosophy	0.0	0.0	0.8	0.3	0.0	0.7	0.0	0.0	0.0
speech	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.1
theater or drama	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
theology or religion	0.0	0.0	0.8	0.5	0.0	0.5	0.3	0.4	1.3
other arts and humanities	0.0	0.0	0.4	0.0	0.6	0.5	0.0	0.0	0.4
Biological Sciences									
biology (general)	0.2	0.0	0.6	0.3	0.0	0.7	4.2	2.5	0.6
biochemistry or biophysics	0.3	0.6	1.0	2.2	1.5	1.2	4.4	3.6	0.6
botany	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.8	0.0
marine (life) science	0.0	0.0	0.0	0.0	0.0	0.2	2.4	2.5	0.0
microbiology or bacteriology	0.0	0.0	0.2	0.0	0.0	0.2	4.7	3.9	0.1
zoology	0.0	0.0	0.4	0.0	0.0	0.7	1.5	3.2	0.1
other biological sciences	0.3	0.6	2.0	1.1	1.7	2.4	11.0	11.0	1.3
Business									
accounting	0.0	0.0	1.8	0.3	0.2	3.4	0.2	0.7	0.6
business admin (general)	17.2	12.2	14.5	6.2	7.0	9.3	2.4	2.5	7.0
finance	1.2	2.8	6.3	1.1	1.1	4.9	0.2	0.4	3.3
marketing	1.1	0.0	4.1	0.3	0.6	1.7	0.2	0.4	2.0
management	7.5	5.6	6.9	1.6	5.1	5.1	0.8	0.4	4.1
secretarial studies	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1
other business	0.8	0.0	2.0	1.1	0.9	1.2	0.3	0.0	1.7
Education									
business education	0.0	0.6	0.2	0.0	0.0	0.2	0.0	0.0	0.1
elementary education	0.0	0.0	0.8	0.3	0.4	2.7	0.2	0.4	3.2
music or art education	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.4
physical education or recreation	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.7	0.9
secondary education	0.6	0.6	1.8	5.1	6.2	2.7	1.8	2.5	2.7
special education	0.0	0.0	0.4	0.0	0.0	1.0	0.3	0.4	1.0
other education	0.2	0.6	1.2	1.1	0.9	3.2	0.5	1.1	2.0
Engineering									
aeronautical/astronautical eng	6.1	4.4	1.4	0.3	1.7	0.5	0.2	0.0	0.0
civil engineering	5.4	7.2	1.4	0.0	0.9	0.5	0.3	0.0	0.1
chemical engineering	3.0	2.8	0.0	0.3	0.4	0.2	0.0	0.0	0.5
electrical/electronic eng	18.6	13.3	2.6	2.2	1.7	2.0	0.0	0.0	0.0
industrial engineering	3.0	3.9	0.6	0.3	0.9	0.5	0.0	0.0	0.0
mechanical engineering	10.7	10.6	1.4	0.5	0.2	1.7	0.0	0.0	0.1
other engineering	8.5	9.4	2.6	2.4	1.9	0.7	0.3	0.0	0.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
Probable Graduate Major									
Physical Sciences									
astronomy	0.2	0.6	0.6	2.4	0.9	0.0	0.0	0.0	0.0
atmospheric science	0.0	0.0	0.2	0.5	0.4	0.2	0.0	0.0	0.0
chemistry	0.0	0.0	1.8	10.5	11.5	0.7	0.5	1.1	4.0
earth science	0.0	0.0	0.8	4.6	3.6	0.0	0.2	0.0	0.6
marine science	0.0	0.6	0.6	1.3	1.1	0.0	0.0	0.0	0.3
mathematics	0.2	1.1	1.4	10.8	7.2	1.0	0.0	0.0	0.6
physics	0.3	1.7	3.7	12.1	5.3	0.7	0.0	0.0	0.0
statistics	0.0	0.6	0.0	3.8	1.7	0.5	0.0	0.0	0.1
other physical sciences	0.3	0.0	0.4	1.3	1.3	0.2	0.2	0.0	0.3
Professional									
architecture/urban planning	0.2	0.6	1.2	0.5	0.4	0.5	0.0	0.4	0.6
home economics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
health technology	0.9	1.7	1.0	1.6	2.3	2.0	15.7	11.4	4.5
law	3.6	5.6	6.3	1.3	1.1	8.3	1.5	1.8	11.4
library or archival science	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.7	0.1
nursing	0.0	0.0	0.0	0.0	0.0	0.5	0.6	0.7	1.4
pharmacy	0.0	0.0	0.0	0.5	1.3	0.2	2.3	3.9	0.5
predent,premed,prevet	1.4	1.7	2.0	1.1	4.7	2.9	23.9	16.7	7.4
therapy (phys,occupat,etc)	0.2	0.0	1.0	0.0	0.9	1.0	3.6	8.9	1.5
other professional	0.3	1.1	1.0	0.5	2.1	1.2	7.4	4.6	3.6
Social Sciences									
anthropology	0.0	0.0	0.2	0.0	0.0	0.2	0.2	0.4	0.4
economics	0.0	0.0	0.6	0.3	0.6	1.5	0.2	0.4	1.5
ethnic studies	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.1
geography	0.0	0.6	0.0	0.0	0.0	0.0	0.2	0.0	0.0
political science	0.5	1.1	4.3	0.8	0.6	2.0	0.3	0.7	1.5
psychology	0.0	0.0	2.9	0.5	0.4	4.2	1.0	0.4	9.1
social work	0.0	0.0	0.2	0.0	0.0	1.2	0.2	1.1	2.2
sociology	0.0	0.0	0.0	0.3	0.0	1.2	0.0	0.0	0.4
women's studies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
other social sciences	0.0	0.0	0.4	0.0	0.0	0.7	0.0	0.4	0.6
Technical									
building trades	0.0	0.6	0.0	0.0	0.0	0.0	0.2	0.0	0.1
data processing,computer prog	0.9	1.7	1.8	1.6	1.7	3.2	0.3	0.0	0.5
drafting or design	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
electronics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mechanics	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
other technical	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Fields									
agriculture	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.4	0.3
communications	0.0	0.0	0.4	0.3	0.0	0.5	0.2	0.0	0.3
computer science	3.1	2.2	2.6	11.9	10.0	2.7	0.0	0.4	0.5
forestry	0.0	0.6	0.0	0.0	0.2	0.0	0.2	0.4	0.1
law enforcement	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.4	0.1
military science	0.2	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.1
other field	0.6	0.0	1.0	0.5	0.4	1.0	0.6	0.7	1.0
undecided	2.3	2.2	3.3	2.4	4.5	3.4	2.1	4.6	3.3

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
Classes/Labs									
none	0.4	0.4	0.5	0.0	0.3	0.0	0.0	0.3	0.6
less than one	0.2	0.0	0.7	0.2	0.3	0.3	0.0	0.0	0.1
1 to 2	0.8	1.1	2.0	1.7	1.1	0.5	0.9	1.3	1.4
3 to 5	5.5	1.9	4.1	3.2	3.9	3.7	4.5	2.6	4.4
10-Jun	8.4	12.5	10.8	11.8	11.0	14.7	8.2	9.0	12.6
15-Nov	20.2	23.1	29.7	34.3	26.5	35.5	21.2	19.3	32.8
16 - 20	36.7	43.2	33.1	26.9	33.6	29.4	33.9	38.1	30.0
over 20	27.8	17.8	19.1	21.9	23.3	15.9	31.3	29.4	18.2
Studying/Homework									
none	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.3	0.1
less than one	0.3	0.0	0.4	0.4	0.5	0.3	0.2	0.3	0.4
1 to 2	1.2	1.5	2.9	2.7	2.6	2.2	1.1	2.9	2.7
3 to 5	6.7	7.2	15.4	10.6	10.2	14.6	11.6	9.8	12.8
10-Jun	17.0	18.9	23.4	20.1	22.1	25.3	26.6	22.3	28.0
15-Nov	20.4	14.0	19.8	22.6	20.4	19.3	21.6	26.5	21.9
16 - 20	19.4	25.3	16.1	18.0	21.5	17.1	17.3	14.9	15.7
over 20	35.0	33.2	21.8	25.6	22.6	21.3	21.4	23.1	18.4
Socializing with Friends									
none	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.1
less than one	0.6	1.1	1.1	1.3	0.3	0.5	0.5	0.3	0.6
1 to 2	4.3	5.0	4.0	3.8	4.0	3.7	4.7	5.1	3.8
3 to 5	16.0	23.7	17.4	14.1	15.9	17.9	18.7	17.3	17.2
10-Jun	31.4	27.1	28.5	27.6	30.7	27.4	29.5	29.5	29.0
15-Nov	18.5	21.4	16.4	19.6	17.3	15.0	19.3	20.5	19.0
16 - 20	13.7	9.9	13.0	13.1	13.4	12.3	12.1	10.9	12.3
over 20	15.2	11.8	19.7	20.5	18.1	23.0	15.2	16.5	18.1
Talk with Faculty Outside Class									
none	7.6	9.1	8.0	4.0	3.9	5.9	7.0	6.9	5.4
less than one	44.0	42.3	39.7	32.1	32.4	33.6	32.8	34.9	35.0
1 to 2	36.3	38.1	34.2	42.2	39.8	43.5	39.3	39.9	37.9
3 to 5	9.8	9.4	14.9	16.2	19.0	14.2	16.2	14.0	16.9
10-Jun	1.9	0.8	2.7	3.6	3.7	2.3	3.6	3.7	3.6
15-Nov	0.2	0.0	0.4	1.5	0.8	0.3	0.7	0.3	0.9
16 - 20	0.2	0.4	0.1	0.4	0.3	0.2	0.1	0.0	0.2
over 20	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.2
Exercising/Sports									
none	4.5	6.8	5.2	5.3	4.5	6.5	5.6	3.4	3.8
less than one	10.2	12.1	8.8	13.7	11.0	12.0	12.2	12.4	12.1
1 to 2	21.1	18.9	19.5	23.8	22.9	22.7	20.8	24.1	22.4
3 to 5	30.0	30.6	28.9	29.7	28.8	26.6	31.6	28.6	32.6
10-Jun	20.8	20.4	21.1	16.4	17.1	17.9	18.2	18.8	17.2
15-Nov	7.8	6.8	8.8	5.5	7.8	7.0	5.8	7.4	6.6
16 - 20	2.3	3.4	4.4	2.9	4.5	3.8	3.1	2.4	2.5
over 20	3.3	1.1	3.3	2.7	3.4	3.3	2.7	2.9	2.8

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
Reading for Pleasure									
none	29.8	28.7	23.4	21.5	23.6	24.5	27.8	27.5	19.9
less than one	29.2	25.7	26.8	29.3	30.3	31.4	26.4	29.4	31.0
1 to 2	26.0	24.9	26.7	25.9	24.9	22.7	27.9	24.3	28.6
3 to 5	9.6	15.5	14.7	14.5	13.4	14.6	13.0	14.6	14.8
10-Jun	4.3	3.8	6.7	5.3	6.0	3.9	4.2	3.4	4.2
15-Nov	1.0	1.1	0.7	1.9	1.0	2.0	0.4	0.5	1.2
16 - 20	0.1	0.0	0.3	0.6	0.3	0.8	0.2	0.3	0.3
over 20	0.0	0.4	0.8	1.1	0.5	0.2	0.1	0.0	0.1
Using a Personal Computer									
none	7.1	11.1	14.2	16.3	14.3	17.1	28.8	27.0	21.9
less than one	11.1	13.4	15.9	13.5	11.7	12.8	17.9	21.9	14.4
1 to 2	22.0	22.9	22.6	20.1	23.5	22.0	22.3	23.3	21.8
3 to 5	28.6	26.0	22.4	22.2	21.8	24.3	20.7	18.7	20.2
10-Jun	17.4	15.6	12.1	12.7	12.3	11.4	6.8	6.7	12.4
15-Nov	6.9	7.3	5.9	6.6	6.2	6.0	2.4	1.3	5.2
16 - 20	2.7	1.9	3.3	3.6	4.5	2.7	0.2	0.5	2.1
over 20	4.1	1.9	3.6	5.1	5.7	3.7	0.9	0.5	2.0
Partying									
none	12.8	19.8	12.7	20.3	16.0	15.2	15.7	15.4	13.6
less than one	12.0	14.4	15.5	17.4	14.9	15.4	14.3	12.5	11.7
1 to 2	19.2	18.6	16.9	16.5	19.6	17.3	19.4	18.1	18.1
3 to 5	29.0	22.1	26.3	23.7	24.8	22.9	27.4	28.2	27.5
10-Jun	18.2	17.9	13.8	12.1	13.3	16.2	13.7	16.2	17.3
15-Nov	5.6	5.7	7.4	5.3	6.3	4.9	5.0	5.3	5.8
16 - 20	1.6	0.4	3.1	1.9	2.6	4.0	2.1	2.7	3.3
over 20	1.6	1.1	4.3	2.8	2.4	4.0	2.5	1.6	2.7
Working (for Pay)									
none	43.4	40.0	34.0	20.8	25.3	26.3	24.8	24.9	23.8
less than one	1.8	1.9	2.1	2.1	1.3	1.0	1.0	1.1	2.0
1 to 2	3.8	3.8	2.1	4.0	3.9	3.7	2.9	2.1	2.9
3 to 5	8.2	7.9	4.9	10.9	11.0	8.7	11.7	9.0	8.5
10-Jun	16.6	12.5	14.8	24.4	22.3	17.6	21.2	23.5	19.4
15-Nov	9.3	11.7	11.2	14.7	11.8	13.1	15.5	17.2	16.1
16 - 20	9.0	9.8	12.7	9.7	11.1	13.6	12.2	10.6	13.1
over 20	7.9	12.5	18.0	13.3	13.4	15.9	10.7	11.6	14.0
Volunteer Work									
none	71.5	68.4	65.3	68.2	60.2	63.8	58.1	59.5	56.1
less than one	12.9	18.6	14.6	13.1	16.1	14.0	11.7	13.0	14.5
1 to 2	10.0	7.6	12.2	11.9	13.5	11.3	14.5	9.8	13.5
3 to 5	4.3	2.7	4.7	4.9	7.9	7.7	10.7	10.8	9.5
10-Jun	1.0	2.7	2.1	1.3	1.0	1.9	3.5	3.7	3.9
15-Nov	0.1	0.0	0.4	0.2	0.3	0.8	0.7	0.5	0.7
16 - 20	0.1	0.0	0.3	0.0	0.5	0.2	0.6	0.8	0.8
over 20	0.1	0.0	0.4	0.4	0.5	0.3	0.0	1.9	1.0

DESCRIPTIVE PROFILE OF PERSISTERS, DEFECTORS, RECRUITS: MAJORS

ITEM	ENGINEERING			PHYSICAL SCI			BIOLOGICAL SCI		
	Persist	Recruit	Defect	Persist	Recruit	Defect	Persist	Recruit	Defect
HOURS PER WEEK IN THE PAST YEAR SPENT ON									
Student Clubs/Groups									
none	27.5	31.7	34.8	36.7	32.1	32.7	25.2	34.6	28.8
less than one	15.9	12.6	14.2	15.3	13.1	13.2	13.0	13.6	12.3
1 to 2	26.1	26.0	23.8	19.1	26.6	25.0	26.9	27.1	23.8
3 to 5	19.4	18.3	15.4	19.3	17.7	16.2	23.3	13.0	20.4
10-Jun	6.8	6.5	7.0	6.4	7.8	7.3	8.3	6.6	9.1
15-Nov	2.1	2.7	3.1	1.7	1.0	2.5	1.8	1.6	2.8
16 - 20	1.3	1.1	0.9	0.6	1.0	1.3	1.0	0.8	0.9
over 20	1.1	1.1	0.8	0.8	0.8	1.9	0.6	2.7	2.0
Watching TV									
none	11.1	15.6	9.5	12.6	13.3	10.7	10.2	11.2	13.4
less than one	13.6	13.3	11.5	15.8	14.4	13.1	12.3	14.4	14.3
1 to 2	19.4	18.3	22.0	19.8	20.9	19.7	22.8	21.0	19.0
3 to 5	26.9	29.7	26.5	23.6	25.2	28.0	29.7	24.5	26.2
10-Jun	17.6	13.7	20.3	17.3	16.7	17.5	15.8	18.6	16.5
15-Nov	6.6	6.1	4.9	5.9	5.5	5.3	5.7	6.1	6.3
16 - 20	2.7	2.7	3.1	2.9	2.3	3.2	1.9	2.1	1.8
over 20	2.1	0.8	2.3	2.1	1.8	2.7	1.5	2.1	2.6
Commuting to Campus									
none	51.3	43.9	45.9	58.3	56.2	48.7	46.9	43.0	47.6
less than one	16.1	17.6	17.2	14.2	14.1	15.0	20.2	19.9	19.5
1 to 2	14.9	11.8	17.6	12.3	13.0	14.1	14.6	14.9	14.1
3 to 5	11.6	16.4	11.9	10.2	9.3	12.6	12.7	14.3	11.2
10-Jun	5.1	8.8	4.9	3.8	5.5	7.4	4.6	6.4	5.9
15-Nov	0.6	1.5	1.7	1.1	1.3	1.3	0.7	0.5	1.4
16 - 20	0.2	0.0	0.4	0.2	0.5	0.3	0.1	0.5	0.1
over 20	0.1	0.0	0.3	0.0	0.2	0.5	0.0	0.5	0.3
Religious Services/Meetings									
none	50.5	54.0	47.7	50.9	49.7	54.0	47.6	53.6	49.4
less than one	18.2	13.3	15.3	13.7	16.8	15.8	16.6	15.1	16.4
1 to 2	23.8	24.7	28.0	27.2	24.0	20.5	25.7	23.3	26.1
3 to 5	5.2	7.2	6.3	6.5	7.3	8.1	8.3	6.4	5.7
10-Jun	1.7	0.8	2.3	1.1	2.1	1.3	1.4	1.1	1.7
15-Nov	0.2	0.0	0.4	0.2	0.0	0.2	0.4	0.3	0.3
16 - 20	0.2	0.0	0.1	0.4	0.2	0.0	0.1	0.3	0.3
over 20	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Hobbies									
none	26.3	27.8	23.8	27.9	24.4	25.1	24.4	25.7	24.1
less than one	24.4	17.9	19.7	20.5	23.4	22.4	22.6	20.4	23.2
1 to 2	27.0	31.6	26.1	27.1	25.2	29.3	28.7	29.6	27.8
3 to 5	16.1	16.3	18.4	14.0	17.1	15.8	17.9	18.0	17.5
10-Jun	3.8	4.2	8.2	7.2	6.2	5.1	4.5	4.8	4.6
15-Nov	1.1	0.4	2.3	1.9	2.1	0.8	1.1	0.5	1.1
16 - 20	0.5	0.8	0.4	0.2	1.0	0.3	0.2	0.5	0.8
over 20	0.8	1.1	1.2	1.3	0.7	1.2	0.5	0.5	0.8

Appendix D

Trends in Freshmen Majors and Careers in Science

APPENDIX D

Trends in Freshmen science major and career interests by gender: 1970-1991*

	1970			1975			1980			1985			1988			1991		
Major fields	M	W	T	M	W	T	M	W	T	M	W	T	M	W	T	M	W	T
Biological science[a]	7.6	3.2	5.5	12.8	7.4	10.2	7.8	5.6	6.3	6.6	4.4	5.4	6.5	4.5	5.4	7.5	5.5	6.4
Engineering	15.9	0.4	8.6	4.0	1.3	7.9	21.0	3.2	11.8	19.3	3.0	10.7	17.5	2.6	9.5	18.7	2.9	10.1
Physical sciences[b]	6.6	4.4	5.6	5.1	2.4	3.8	3.6	1.6	2.6	3.1	1.7	2.4	2.9	1.6	2.1	2.8	1.6	2.2
Social sciences	5.8	12.5	8.9	3.7	8.9	6.2	2.3	6.8	4.7	2.7	7.3	5.2	3.4	8.8	6.3	5.9	10.8	8.4
Career fields																		
Doctor[c] (MD/DDS)	5.9	1.5	3.9	6.6	3.3	5.1	6.9	4.4	6.3	6.3	5.9	6.4	6.3	6.7	6.5	6.8	8.3	7.4
Engineer	13.3	0.4	7.5	10.2	1.1	5.9	19.1	2.9	10.7	17.7	2.9	10.0	15.7	2.5	8.6	16.2	2.7	9.0
Research scientist	3.5	1.6	2.6	2.5	1.5	2.0	2.2	1.3	1.7	1.7	1.2	1.4	2.0	1.3	1.6	1.8	1.2	1.5

*1970-1988 data taken from (Dey, Astin, & Korn, 1991). 1991 data taken from (Astin, et. al, 1991).

[a] Includes agriculture and forestry

[b] Includes mathematics and statistics

[c] Includes physicians, dentists, optometrists, pharmacists, and veterinarians

Appendix E

Site Visit Protocols

SCIENCE STUDENTS

Introduction:

Introduce yourself; introduce study
Ask students to give name, major: Note the number of students, characteristics, etc.
Note description of room; take notes and tape all interviews

1. **What attracted you to this institution?**
   - Did it have anything to do with the science program?

2. **How and when did you make the decision to major in the sciences?**
   - Was it something that you always knew or did you make the decision later in your schooling (like in high school or college)?
   - Have you shifted between fields within the sciences or from another discipline? If so, why? To/from what field did you move?
   - When do students have to declare their major?

3. **What is it like to be a science major here?**
   - Is the experience different for men and women? for minorities?
   - Is the experience different for non–science majors?
   - Is the experience different among science fields (i.e., hard sci vs. engineering)?

4. **What does it take to succeed as a science major here?**
   - Is it different for men, women, minorities?
   - Are there things that the institution does to help or hinder your success?
   - Are there specific programs to assist you?
   - To what do you attribute the general underrepresentation of women and minorities in the sciences?
   - What might be done to attract more people, in particular women and minorities, to the sciences?

5. **What role do faculty play in your experience as a science student?**
   - How do they facilitate or inhibit your success?
   - Are there opportunities for you to spend time with science faculty outside of the classroom (i.e., working on a faculty research project, or in a mentoring capacity)
   - How are most science courses taught (lecture, lab, seminar) ?
   - Do you think this is an effective way of teaching the course material? What are the strengths, weaknesses, suggestions for improvement?
   - What percentage of science courses are taught by graduate teaching assistants? How does this help or hinder your ability to succeed in science? Please explain.
   - How are you evaluated in your courses? What do you think about this (these) method(s)? Does this differ between lower and upper division classes?
   - How is faculty teaching evaluated?
   - How do students receive advising regarding the sciences at this institution?

6. **How would you characterize the relationship between students within the sciences (i.e., competitive, cooperative)?**
   - How do non-science students view the sciences and science students at this institution?

7. **What do you plan to do with your degree (academic, private industry, teaching)?**
   - Have your plans changed since you entered this institution?

NON-SCIENCE STUDENTS

Introduction:
Introduce yourself; introduce study
Ask students to give name, major: Note the number of students, characteristics, etc.
Note description of room; take notes and tape all interviews

1. **What attracted you to this college?**

2. **How and why did you choose your major?**
   - Were you ever interested in the sciences?
   - If not, how come?

3. **What has been your experience in (GE) science courses here?**
   - Do you like science courses? Are they difficult?
   - How do the professors view you?
   - What is the nature of student interaction in science courses that you've taken (i.e., competitive, cooperative)?
   - Do you feel you had the background to major in science?

4. **What does it take to succeed as a science major here?**
   - Is it different for men, women, minorities?
   - Are there specific programs to assist you?
   - To what do you attribute the general underrepresentation of women and minorities in the sciences?
   - What might be done to attract more people, in particular women and minorities, to the sciences?

5. **How do you view the science program and science majors at this institution?**
   - Do you have any friends that are science majors? If not, why?

FACULTY

Introduction:
Introduce yourself; introduce study
Ask faculty to give name, field: Note the number of students, characteristics, etc.
Note description of room; take notes and tape all interviews

1. **How does science fit into the overall context of this institution?**
   - What is the history of the sciences at this institution?

2. **There has been lots of hype about the shortage of science talent, what is the nature of science enrollments here?**
   - Has there been declining or increasing enrollments?
   - Do you do anything to encourage science enrollments?

3. **What is it like for students to be science majors here?**
   - Is the experience different for men and women?
   - Is the experience for minorities different?
   - Does it differ by field (i.e., natural sci vs. math)

4. **What does it take for students to succeed in the sciences here?**
   - Are there things about this institution that help or hinder this success?
   - Are things done at this institution to help students who are less prepared in the sciences, but who want to pursue science in college?
   - At what point do you lose students from science?
   - Do you track where students who leave the sciences go?
   - If not, where do you think they are going? (Other science fields, or outside of science?)

5. **How do you feel about the quality/academic preparation of your students?**
   - Do you do anything to encourage science enrollment?
   - To what do you attribute the general underrepresentation of women and minorities in the sciences?
   - What might be done to attract more people, in particular women and minorities, to the sciences?

6. **What role do faculty play in the experience of science students?**
   - Are there opportunities for students to spend time with you outside of the classroom (i.e., faculty research, mentoring)?
   - How are most science courses taught (lecture, lab, seminar) ?
   - Do you think this is an effective way of teaching the course material? What are the strengths, weaknesses, suggestions for improvement?
   - What percentage of science courses are taught by graduate teaching assistants? How does this help or hinder your ability to succeed in science? Please explain.
   - How do you evaluate student academic performance in your courses? What do you think about this (these) method(s)? Does this differ between lower and upper division classes?
   - How is your teaching evaluated?
   - How do students receive advising regarding the sciences at this institution?

ADMINISTRATORS

Introduction:

Introduce yourself; introduce study
Ask faculty to give name, field: Note the number of students, characteristics, etc.
Note description of room; take notes and tape all interviews

ONLY FOR PROGRAM DIRECTORS

A. Tell us about the program you run? Who is targeted to participate in your program and why?

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1. How does science fit into the overall context of this institution?
- What is the history of the sciences at this institution?

2. There has been lots of hype about the shortage of science talent, what is the nature of science enrollments here?
- Has there been declining or increasing enrollments?
- Do you do anything to encourage science enrollments?

3. What is it like for students to be science majors here?
- Is the experience different for men and women?
- Is the experience for minorities different?
- Does it differ by field (i.e., natural sci vs. math)

4. What does it take for students to succeed in the sciences here?
- Are there things about this institution that help or hinder this success?
- Are things done at this institution to help students who are less prepared in the sciences, but who want to pursue science in college?
- At what point do you lose students from science?
- Do you track where students who leave the sciences go?
- If not, where do you think they are going? (Other science fields, or outside of science?)

5. How do you feel about the quality/academic preparation of your students?
- Do you do anything to encourage science enrollment?
- To what do you attribute the general underrepresentation of women and minorities in the sciences?
- What might be done to attract more people, in particular women and minorities, to the sciences?

6. What role do administrators play in the experience of science students?

7. What role do faculty play in the experience of science students?
- Are there opportunities for students to spend time with faculty outside of the classroom (i.e., faculty research, mentoring)?
- How is teaching evaluated?
- How do students receive advising regarding the sciences at this institution?